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AERONAUTICAL ENGINEERING

**A SPECIAL BIBLIOGRAPHY
WITH INDEXES
Supplement 22**

SEPTEMBER 1972

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA SP-7037 (22)

AERONAUTICAL ENGINEERING

Pages 393-439
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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 22

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in August 1972 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SEPTEMBER 1972

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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 353 reports, journal articles, and other documents originally announced in August 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citations and abstracts are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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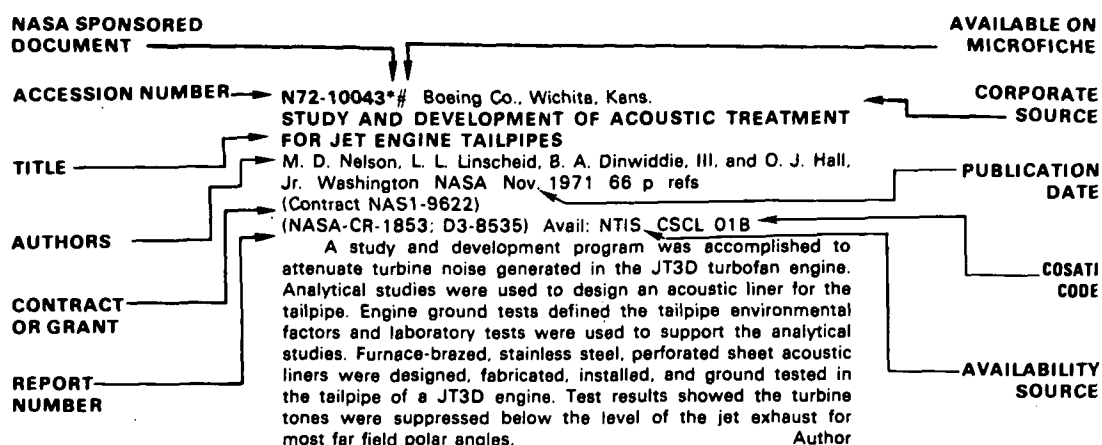
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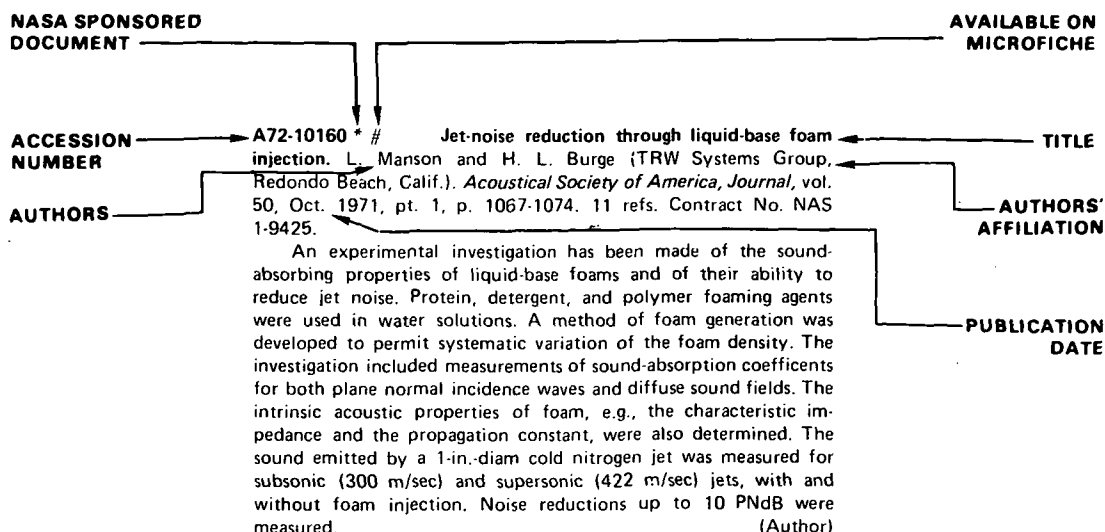
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AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 22) SEPTEMBER 1972

IAA ENTRIES

A72-31178 # Electronic equipment for data and signal processing on board civil aircraft (Elettronica per la elaborazione dei dati e dei segnali a bordo degli aerei civili). F. Polloni (Alitalia Linee Aeree Italiane S.p.A., Rome, Italy). In: International Electronics Conference, 19th, Rome, Italy, March 27-30, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica e Nucleare, 1972, p. 81, 83-88. In Italian.

Description of recently developed avionics equipment designed to improve flight safety. The use of single sideband modulation to achieve a substantial improvement in aircraft-to-ground communications is noted, as well as the use of 'area navigation' based on an improvement in the aircraft trajectory and the introduction of 'waypoints.' The use of the Mark I, II, and III systems for gyroscope drift correction is discussed, as well as the operation of the Omega navigation system. The orientation of designers toward the use of digital rather than analog computers is noted, as well as the trend toward the elimination of mechanical parts from electronic devices and the almost complete elimination of potentiometers, due to the wide-scale substitution of linear circuits by circuits of on-off type.

A.B.K.

A72-31180 # Evolution of aeronautical communications - Critical analysis of the technical and economic aspects (Evoluzione delle telecomunicazioni aeronautiche - Analisi critica degli aspetti tecnici ed economici). P. Scravaglieri and G. Rossi (Italcable S.p.A., Rome, Italy). In: International Electronics Conference, 19th, Rome, Italy, March 27-30, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica e Nucleare, 1972, p. 203, 205-211. 8 refs. In Italian.

Technical and economic survey of the progress recently achieved in the field of aeronautical communications via satellite. Some problems connected with wave propagation and noise are reviewed, and suggestions are made concerning the radiating system on board the aircraft. The adoption of a preoperational phase is proposed in which the VHF and UHF links in satellite communication systems are tested during operation together with conventional systems.

A.B.K.

A72-31201 Israel Annual Conference on Aviation and Astronautics, 14th, Tel Aviv and Haifa, Israel, March 1, 2, 1972, Proceedings. Conference convened by the Israel Society of Aeronautics and Astronautics; Technion - Israel Institute of Technology, Department of Aeronautical Engineering; Israel Ministry of Transport, Civil Aviation Administration; Israel National Committee for Space Research; Tel Aviv University, Department of Environmental Sciences and Institute of Planetary and Space Science; University of the Negev, Faculty of Engineering Sciences; Israel

Aircraft Industries; and Israel Airlines, El-Al. Conference supported by the Israel Ministry of Transport; Israel Ministry of Defence, Armament Development Authority; Israel Ministry of Commerce and Industry; Technion - Israel Institute of Technology; Tel Aviv University; University of the Negev; Aviation Services; and IBM (Israel). (*Israel Journal of Technology*, vol. 10, no. 1-2, 1972.) Jerusalem, Weizmann Science Press of Israel, 1972. 161 p. In English and French.

The papers deal with development in aeroelasticity, the application of direct methods for investigation of stability and transient motion of rotationally symmetric flying vehicles, heat transfer in turbulent separated flow downstream of a rearward facing step, boundary layers of axisymmetric bodies at small angles of attack, and the design of axisymmetric convergent cones with plane sonic outlets. Attention is given to a parametric study of a hybrid rocket motor, an aerodynamic study of two-stream propulsion systems, flow field diagnostics in rarefied slightly ionized hypersonic flow, the aeroelastic equations of a slender rotating body, nonlinear flap lag stability of hingeless helicopter blades, the nonlinear stability of hydromagnetic flows, and impurities effects on the ionization-relaxation zone behind strong normal shock waves in monatomic gases.

F.R.L.

A72-31202 * Perspectives in aeroelasticity. I. E. Garrick (NASA, Langley Research Center, Hampton, Va.). (*Israel Journal of Technology*, vol. 10, no. 1-2, 1972.) In: Israel Annual Conference on Aviation and Astronautics, 14th, Tel Aviv and Haifa, Israel, March 1, 2, 1972, Proceedings. Jerusalem, Weizmann Science Press of Israel, 1972, p. 1-22. 52 refs.

Based on selected topics, the paper is broadly aimed to indicate achievements of the past decade, the state of the art, and trends in aeroelasticity. Topics selected for this end include: brief orientation into the history of the subject, roles of active controls and the concept of aerodynamic energy in load alleviation and in flutter suppression, computerized aeroelastic analysis, aeroelastic effects in stability, aeroelastic optimization, the use of composites, recent applications of lifting surface theory to interfering surfaces and control surfaces, transonic flow considerations, and some problems related to the space shuttle.

(Author)

A72-31211 Nonlinear flap lag stability of hingeless helicopter blades. P. Friedmann and P. Tong (MIT, Cambridge, Mass.). (*Israel Journal of Technology*, vol. 10, no. 1-2, 1972.) In: Israel Annual Conference on Aviation and Astronautics, 14th, Tel Aviv and Haifa, Israel, March 1, 2, 1972, Proceedings. Jerusalem, Weizmann Science Press of Israel, 1972, p. 133-143. 11 refs. Army-supported research.

Equations for large amplitude coupled flap-lag motion of hingeless elastic helicopter blades are derived. Only torsionally rigid blades excited by quasi-steady aerodynamic loads are considered. The nonlinear equations of motion in the time and space variables are reduced to a system of coupled nonlinear ordinary differential

equations with periodic coefficients, using Galerkin's method for the variables. The resulting nonlinear system of ordinary differential equations has been solved for the case of one elastic mode in each degree of freedom using the predictor-corrector method. Results, showing limit-cycle amplitudes, are given for the nonlinear response of a blade under typical conditions. (Author)

A72-31215 Relay operation at reduced system voltage. M. G. Freed and R. Steiner (North American Rockwell Corp., Los Angeles, Calif.). In: Annual National Relay Conference, 20th, Stillwater, Okla., April 18, 19, 1972, Proceedings.

Scottsdale, Ariz., National Association of Relay Manufacturers, 1972, p. 3-1 to 3-8.

Adaptation of existing hardware in conjunction with a series capacitor to make it possible to supply power to components capable of operating at high voltage. The use of a capacitor is desirable because it functions without noticeable heat emission. The theoretical background, a laboratory test arrangement, and the advantages of such a voltage reduction technique applied to a 230 volt ac 400 Hz system are described. Recommendations are made for the practical application of this method. F.R.L.

A72-31320 The RTOL means quieter air travel. K. Wilkinson (British European Airways Corp., Ruislip, Middx., England). *New Scientist*, vol. 54, Apr. 13, 1972, p. 79-82.

It is pointed out that the short haul air traveler has gained little or nothing in end-to-end journey time since the Second World War. A number of difficulties delay the introduction of the vertical takeoff or even short takeoff civil airliner. In the meantime, the RTOL - a quiet 'reduced' takeoff aircraft - would help meet the growth in short haul traffic and bring at last some peace to the vicinity of airports. Taking the case of an RTOL aircraft designed for a stage length of 650 nautical miles and comparing direct and total costs relative to a present-day Trident 3 aircraft indicates that almost identical costs could be expected for stage length up to the design range. The RTOL benefits from its reduced taxi times, somewhat more direct air routings and reduced landing fees due to its shorter, cheaper runways. G.R.

A72-31401 Vortex-lattice method for calculating aerodynamic coefficients of a subsonic airplane. H. M. Hua. *Astronautical Society of the Republic of China, Transactions*, Nov. 1, 1971, p. 1-22. 8 refs.

The vortex-lattice method has been quite successful in optimizing the nonplanar wing and body combination. This method is now being extended to calculate the aerodynamic coefficients of a subsonic airplane. In this extension, the horseshoe vortices are oriented with the sweep, dihedral, and twist angles of lifting surfaces, and also the angles of attack and yaw. The strength of the vortices is determined with the argument that the total velocity at every control point should be parallel to the surface. The force vectors and also the aerodynamic coefficients are then calculated according to the local velocities and the vortices. The method has been verified with the lifting surfaces of the L-1011 airbus and its wind tunnel test data.

(Author)

A72-31403 An inclined gliding tunnel and techniques developed for aerodynamic design of flexible wing. S.-C. Ma (Chung-Shan Institute of Science and Technology, Nationalist China). *Astronautical Society of the Republic of China, Transactions*, Nov. 1, 1971, p. 44-55. 6 refs.

The development of an inclined type of test section suitable for flexible wing aerodynamic design is described. This type of test section provides a possibility for the close investigation of the free gliding of a flexible-wing two body system by tilting the test section to an appropriate glide angle, thus keeping the payload suspended vertically. The inclined test section is much more handy than the

horizontal test section of conventional tunnels for static testing of wing canopy rigging. This paper demonstrates the potential of the inclined test section for use in aerodynamic design of a flexible wing through a description of the technique developed for a 1.5-sq ft flexible wing model and its 230-sq ft full scale. (Author)

A72-31407 A nonlinear analysis of the transverse vibration of a helicopter rotor blade. C. Y. Lee (Chinese Air Force, Taipei, Nationalist China) and L. C. Jean (Chung-Hsing University, Nationalist China). *Astronautical Society of the Republic of China, Transactions*, Nov. 1, 1971, p. 114-134.

In this paper, the transverse vibration of a specific helicopter rotor blade under both air and centrifugal loadings during forward flight is analyzed using the structural matrix method and considering geometrical nonlinearity due to large displacements. Throughout the analysis, the rotor blade is replaced by an equivalent elastic beam of uniform sections. The displacement matrix which is expressed in terms of free-vibration mode shapes and some time-dependent multipliers is computed. (Author)

A72-31498 # Analysis of a hierarchic system of service stations (Die Analyse eines hierarchischen Systems von Bedienungstationen). A. G. Konheim (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.) and B. Meister (IBM Forschungslaboratorium, Zurich, Switzerland). (*Gesellschaft für angewandte Mathematik und Mechanik, Wissenschaftliche Jahrestagung, Mannheim, West Germany, Apr. 13-17, 1971.*) *Zeitschrift für angewandte Mathematik und Mechanik*, vol. 52, Apr. 1972, p. T 242, T 243. In German.

Two service systems are considered, each consisting of one starting station and nine terminals. In the first, the station and terminals are arranged in the form of a single loop. The second, a multiloop system, is made up of one main loop (with the starting station and three terminals) flanked by two secondary loops (with three terminals each). As additional system components, there are two intermediate stations between the secondary loops and the main one. Under prescribed random processes, passengers arrive at the terminals and wait for transportation by helicopter to the starting station directly, in the first system, and by way of the intermediate stations, in the second system. A simple method is presented for calculating the passenger numbers waiting at the terminals and intermediate stations, on the basis of the given set of assumptions characterizing the process of passenger transportation by helicopter from the terminals and intermediate stations to the starting station. M.V.E.

A72-31596 A plane man's guide to inertial navigation. T. E. Bannan (McDonnell Douglas Corp., St. Louis, Mo.). *Esso Air World*, vol. 24, no. 4, 1972, p. 93-97.

Description of inertial navigation systems, which provide an immediate answer to current vexations and promise a future solution to the entire problem of navigation. The elements of an inertial navigation system (INS) consist of a memory containing the standard latitude and longitude coordinate system and, exclusive of power requirements, its hardware consists of a Mode Selector Unit (MSU), a digital computer and stable platform package called an Inertial Navigation Unit (INU), and a Control Display Unit (CDU) which provides a method of interface, i.e., a way for the operator to communicate with the system. The digital computer, the most complex item, is described in detail. F.R.L.

A72-31601 # Computation of the geodetic coordinates of an aircraft from two range measurements and from its height over the surface of the earth's ellipsoid (Vychislenie geodezicheskikh koordinat samoleta po dvum izmerennym rassstoianiam i ego vysote nad poverkhnost'iu zemnogo ellipsoida). K. A. Laping and L. V. Medvedev. *Geodeziia i Kartografiia*, Mar. 1972, p. 13-15. In Russian.

The antenna coordinates of an airborne radar used to generate geodetic grids can be calculated on the basis of measured range to two initial points and the height of the aircraft above the surface of the earth's ellipsoid. The proposed method does not require approximate knowledge of the aircraft geodetic coordinates, and it is not necessary to reduce the range measurements to the ellipsoid surface.

T.M.

A72-31694 # Tactical Approach Landing Radar. D. Vikan (USAF, Edwards AFB, Calif.). *American Institute of Aeronautics and Astronautics and NASA, Space Shuttle Operations, Maintenance, and Safety Technology Conference, Cocoa Beach, Fla., Mar. 29, 1972, Paper. 34 p.*

The Tactical Approach Landing Radar (TALAR) system was evaluated as a tool for analyzing and investigating the flying characteristics of low L/D aircraft in unpowered approach and landing phases of flight using an F-104D as the test aircraft. The TALAR system evaluated in this program was one which provided the capability of varying the glide slope angle up to 29.5 degrees. Results of the evaluation indicated that the approach parameters used for the TALAR test in terms of altitudes, airspeeds, L/D ratios and configuration changes are reasonable and permit consistently safe predictable approaches.

D.F.L.

A72-31697 * # Flight experiments to determine visibility requirements for approaches and landings. R. Carpenter and J. Manke (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics and NASA, Space Shuttle Operations, Maintenance, and Safety Technology Conference, Cocoa Beach, Fla., Mar. 29, 1972, Paper. 25 p.*

Some of the effects of horizontal visual restriction on the front cockpit of a T-33 aircraft were studied. These studies are pertinent to the establishment of guidelines that will be used in canopy design for limited visibility situations. Results of the study revealed that runway extension lines are helpful for restricted visibility situations. The superiority of a 300-foot runway over a 200-foot runway was greater than expected from geometric considerations. It was also shown that practice learning has a noticeable effect on performance. Finally, visibility restrictions that force a pilot into shallow glides should be avoided, and the available visibility should be sufficient to provide adequate information so that the pilot can solve the lateral-directional and pitch tasks simultaneously.

D.F.L.

A72-31702 # Investigation of a turbulent liquid flow between a rotating disk and a body in a radial direction (Issledovanie turbulentnogo techeniya zhidkosti mezhdu vrashchayushchimsya diskom i korpusom pri radial'nom raskhode). A. S. Baibikov, V. B. Shnepp, and S. S. Evgen'ev. *Energomashinostroenie*, vol. 18, Mar. 1972, p. 20-23. 7 refs. In Russian.

A new integral form of Reynolds equations is introduced which describes the turbulent flow of an incompressible liquid between a rotating disk and a body. Results are presented of an experimental study of the pressure along the radius for the case of a liquid flowing toward the axis of a disk. The results are in good agreement with the theoretical solution.

O.H.

A72-31703 # Cast alloys for turbocompressor blades and turbine wheels (Litye splavy dlya lopatok i turbinnykh kolek TK). M. D. Nikitin and V. P. Prozorov. *Energomashinostroenie*, vol. 18, Mar. 1972, p. 27-29. In Russian.

Short-term and long-term strength characteristics of several high-temperature steels and alloys, employed for manufacturing gas turbine rotors, disks, and blades are presented for a wide range of temperatures. Recommended operating temperatures for the steels and alloys considered are given.

O.H.

A72-31706 # An approximate method of calculation of the effect of the last stages of an axial compressor on its characteristics (Priblizhennyi metod ucheta vlianiia poslednikh stupenei oseвого kompressora na ego kharakteristiku). A. Z. Bagerman and N. P. Rubinovich. *Energomashinostroenie*, vol. 18, Mar. 1972, p. 37-39. In Russian.

An approximate method is proposed for obtaining characteristics of a multistage axial compressor for the case that one or more last stages are either removed or added. Several examples of a practical application of this method are presented.

O.H.

A72-31815 Design considerations for a supersonic combustion facility and discussion of pertinent research areas. T. P. Torda (IIT Research Institute, Chicago, Ill.), B. R. Patel, and H. M. Schoenhoff. In: *International Astronautical Congress, 20th, Mar del Plata, Argentina, October 5-10, 1969, Proceedings.*

Oxford, Pergamon Press, Ltd.; Warsaw, Panstwowe Wydawnictwo Naukowe, 1972, p. 425-443. 42 refs.

Various schemes of sustaining supersonic combustion are classified into three categories: (1) use of the mixing processes between air and fuel streams to sustain and control combustion, (2) use of temperature and pressure increases across a shock to initiate and anchor supersonic combustion, and (3) use of various flame holding devices, including pilot flames to anchor and sustain combustion. Design parameters are given for a Mach 1.5-4 combustion facility which corresponds to various flight corridors. The necessary air temperature and pressure ranges are presented for nonpremixed gaseous injection. In addition to the specific facility design, three areas of basic research are discussed where investigations are of importance for supersonic ramjet design because systematic data are lacking at the present time: mixing processes in the 'near' region coupled with combustion; injection of propellants and their interaction with supersonic flow fields; and limits of flammability in turbulent flows.

(Author)

A72-32017 * # Noise field of a supersonic Mach 1.5 cold model jet. J. C. Yu (George Washington University, Washington, D.C.) and D. S. Dosanjh (Syracuse University, Syracuse, N.Y.). (*Acoustical Society of America, Meeting, 81st, Washington, D.C., Apr. 20-23, 1971.*) *Acoustical Society of America, Journal*, vol. 51, May 1972, pt. 1, p. 1400-1410. 23 refs. Grant No. NGL-33-022-082.

Systematic surveys of both the near and far noise fields were made for a supersonic (nozzle design Mach number 1.5) cold model jet. The purpose of this investigation was to extend the existing understanding of the noise field of a supersonic shock-free jet at a moderate exit Mach number and the variations in its acoustic behavior when the nozzle was operated at its underexpanded mode, where strong shock waves were present. It was found that the broad-band pressure spectra of apparent sources in each of the individual characteristic flow regions were grossly similar. The strongest source for the shock-free jet was located in the region between the laminar core tip and the supersonic core tip, whereas for the underexpanded jet the strongest source was found near the middle of the flow region containing repetitive shock waves. It is shown that the significant increase in the noise output at the underexpanded mode of operation was primarily due to high-frequency components.

(Author)

A72-32019 Blade interaction noise from lift fans. G. Krishnappa (National Research Council, Div. of Mechanical Engineering, Ottawa, Canada). *Acoustical Society of America, Journal*, vol. 51, May 1972, pt. 1, p. 1464-1470. 11 refs.

The discrete-frequency noise radiation from a single-stage lifting fan is analytically estimated from measured steady and unsteady aerodynamic data on the fan and compared with the measured noise levels. Unsteady forces acting on the stator blades are calculated from measurements of the rotor blades' wake, using a hot-wire

anemometer. The viscous interaction noise estimated is compared with the potential interaction noise from the rotor blades. Rotor potential-flow interaction and stator viscous interaction noise both seem to be important in the case of close rotor-stator spacing. The estimated results show a reasonable agreement with the measured results. (Author)

A72-32023 # Airfoil in a contracting or diverging stream. B. Lakshminarayana (Pennsylvania State University, University Park, Pa.) and M. T. White. *Journal of Aircraft*, vol. 9, May 1972, p. 354-360. 6 refs.

Theoretical and experimental investigation of the flow around an airfoil in a contracting or diverging stream. An expression for the vortex distribution, which satisfies the kinematic condition on the airfoil surface and the Kutta condition at the trailing edge, is derived. The predicted values of the lift and the surface pressure distribution, at various values of incidences and mean flow acceleration, agree very well with the measured values. In converging flow, the circulation and lift are found to increase with increase in velocity ratio (ratio of outlet to inlet velocity). Considerable change in airfoil pressure distribution is observed, its effect being dominant on the suction surface. With diverging mean flow, both circulation and lift decrease with decrease in velocity ratio. The decrease in mean velocity seems to have dominant effect on the pressure surface. (Author)

A72-32024 # Some recent MIT research on dynamic stall. N. D. Ham (MIT, Cambridge, Mass.). *Journal of Aircraft*, vol. 9, May 1972, p. 378, 379. 5 refs. Army-Navy-sponsored research.

A summary is presented of a recent study on airfoil dynamic stall. The boundary-layer flow processes during dynamic stall are tentatively defined. Results suggest that the observed delay in the occurrence of leading-edge separation is due to the delay in the forward movement of the reattachment portion of the separation bubble as the angle of attack is increased. O.H.

A72-32025 # Some results of suboptimal gust alleviation. R. A. Hess (U.S. Naval Postgraduate School, Monterey, Calif.). *Journal of Aircraft*, vol. 9, May 1972, p. 380, 381.

Results are presented regarding the gust alleviation design, wherein the desirability of on-line information about the vertical gust angle-of-attack perturbation is demonstrated from the standpoint of mean square performance. In addition, the feedback variables are restricted to those which can be measured most readily. Finally, the resulting feedback configuration is shown to be similar in form to a simple 'acceleration autopilot' and to utilize the so-called 'essential feedbacks' normally associated with effective vertical gust alleviation. O.H.

A72-32042 The true perspective path in the sky, an approach to aircraft navigation. J. La Russa and M. C. Baum (Farrand Optical Co., Inc., Valhalla, N.Y.). In: Electro-Optical Systems Design Conference, New York, N.Y., September 14-16, 1971, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1971, p. 106-113.

Description of a head-up display system that provides a true three-dimensional sky path extending from the aircraft to any desired location such as a touchdown point on a runway. This display literally enables the pilot to 'drive' the aircraft down to a landing. Actual airspeed, desired airspeed, steering errors, crab angle, roll attitude, pitch attitude, angle of attack, runway outline, and an artificial horizon are all provided as picture analogs thereby reducing interpretation time. Computer units, the CRT display system, and image generating subsystems are outlined. T.M.

A72-32045 Design of a laser velocimeter for use in turbomachinery. A. Hauer and W. G. Alwang (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: Electro-Optical Systems Design Conference, New York, N.Y., September 14-16, 1971, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1971, p. 137-153. 21 refs.

The selection of a laser Doppler velocimetry (LVD) system design is discussed that is suitable for the measurement of intrablade flow in turbomachinery. As an optical method for measuring the velocity of flowing fluids, LVD dispenses with the necessity of introducing any hardware into the stream and does away with many of the difficulties and uncertainties experienced with ordinary physical probes. Other advantages are reviewed, and the interrelationships of the instrument design parameters with its performance are examined. The various options available for signal processing are also discussed. M.V.E.

A72-32072 Airborne collision avoidance and other applications of time/frequency. R. E. Perkinson and F. D. Watson (McDonnell Douglas Electronics Co., Saint Charles, Mo.). *IEEE, Proceedings*, vol. 60, May 1972, p. 572-579. 31 refs.

Time/frequency technology provides a reliable aircraft collision avoidance system (CAS) that can operate in either synchronous or asynchronous modes. Precision time-ordered techniques of CAS provide both range and range-rate measurements in a one-way sense to all aircraft as well as ground stations within range of transmitted microwave signals. The cooperative system utilizes exact frequency references coupled with precise synchronization: control of frequency to one part in 100 million and time to less than 1 microsec. In addition to performing specific functions of protecting aircraft, the time/frequency CAS provides a means for wide dissemination of submicrosecond timing. Flying clocks, which are an integral part of the airborne CAS, have been providing transcontinental and intercontinental transfer of time since 1964. CAS ground stations can serve as depositories of time and frequency derived from flying clocks, satellites, Loran-C and Omega navigation systems, or television transfer referenced to national and international time/frequency standards. (Author)

A72-32073 Time/frequency and transportation. C. E. Potts and J. F. Roeber (U.S. Coast Guard, Electronics Engineering Div., Washington, D.C.). *IEEE, Proceedings*, vol. 60, May 1972, p. 579-589. 51 refs.

Current and future problems are presented for the land, sea, and air transportation environments that are, or can be, solved using time/frequency technology. Problem areas encompass vehicle surveillance and location, traffic management, collision avoidance, command and control, communications, navigation, and search and rescue. The need for time/frequency technology in the orderly and safe movement of people and material is shown to be a function of the type of transportation and environment involved. Various characteristics of the transportation environments are discussed, and time-related aspects of transportation are designated. Recommendations are presented for broad coordination in the development and introduction of electronic systems for transportation services. O.H.

A72-32097 Review of models of the air traffic control system. N. Moray and L. D. Reid (Toronto, University, Toronto, Canada). *CATCA Journal*, vol. 4, Spring 1972, p. 9-14. 33 refs.

Attempt to assess the state of the art in fast time simulation of ATC systems, with particular emphasis on models of the human controller. Fast-time simulation is found to be a useful tool for dealing with studies of ATC systems. However, past models have generally failed to include a realistic interactive human controller as part of the simulation. At the present time there is no suitable model for the human controller that will allow a realistic simulation of the

interactive effects involving the human element. More of an applied psychology approach to modeling the controller is required if a realistic model is to be achieved. The simulation should be developed with the close cooperation of ATC personnel to assure a realistic model. F.R.L.

A72-32098 A digital simulator for ATC procedures training. R. Cottis and P. Baird (GEC-Marconi Electronics, Ltd., Chelmsford, Essex, England). *CATCA Journal*, vol. 4, Spring 1972, p. 15, 18, 20.

Discussion of digital radar simulators which can be used for training at all levels. The switch can be made from one training level to another in a very short time. The simulators work with great precision, achieve great realism, and are simple to use. There are always five categories of information which are required for setting an exercise: geography, radar characteristics, wind characteristics, aircraft characteristics, and flight plans. Two types of training program which can be arranged with the digital simulator are considered. F.R.L.

A72-32125 # Results of preliminary parametric design analysis of an Arctic surface effect vehicle. P. R. Scheurich, Jr. and M. A. Kidd (U.S. Naval Material Command, Ship Research and Development Center, Washington, D.C.). (*Canadian Symposium on Air Cushion Technology*, 5th, Ottawa, Canada, Sept. 1, 1971.) *Canadian Aeronautics and Space Journal*, vol. 18, May 1972, p. 129-134. 10 refs.

A discussion is presented of the primary variables of vehicle gross weight, design cushion pressure, vehicle velocity, length/beam ratio and gap height that are considered in the vehicle design and performance trade-off studies. The data are generated by a computer program where each variable in turn is fixed and the remaining parameters are varied to create a matrix of Surface Effect Vehicle (SEV) designs. In addition, the secondary variables of wave height, skirt height, terrain roughness, system efficiencies, fuel and payload fractions, aerodynamic drag and lift coefficients, and the specific fuel consumption have been considered in the design analysis. Conclusions on how these parameters affect the design of a surface effect vehicle are presented. (Author)

A72-32127 * # Engine selection for transport and combat aircraft. J. F. Dugan, Jr. (NASA, Lewis Research Center, Cleveland, Ohio). *NATO, AGARD, Conference on Aircraft Performance - Prediction Methods and Optimization*, Brussels, Belgium, Apr. 24-28, 1972, Paper. 76 p. 23 refs.

Review of the procedures used to select engines for transport and combat aircraft by illustrating the procedures for a long haul CTOL transport, a short haul VTOL transport, a long range SST, and a fighter aircraft. For the CTOL transport, it is shown that advances in noise technology and advanced turbine cooling technology will greatly reduce the airplane performance penalties associated with achieving low noise goals. A remote lift fan powered by a turboprop air generator is considered for the VTOL aircraft. In this case, the lift fan pressure ratio which maximizes payload also comes closest to meeting the noise goal. High turbine temperature in three different engines is considered for the SST. Without noise constraints it leads to an appreciable drop in DOC, but with noise constraints the reduction in DOC is very modest. For the fighter aircraft it is shown how specific excess power requirements play the same role in engine selection as noise constraints for commercial airplanes. F.R.L.

A72-32136 * # Hot-salt stress-corrosion of titanium alloys as related to turbine engine operation. H. R. Gray (NASA, Lewis Research Center, Cleveland, Ohio). *Metallurgical Society and American Society for Metals, International Conference on Titanium*,

2nd, Cambridge, Mass., May 2-5, 1972, Paper. 12 p. 15 refs.

Demonstration that the major variables influencing hot-salt stress-corrosion of titanium alloys are alloy processing conditions, heat-to-heat variations and composition, surface condition, and cyclic exposures. Under simulated compressor environmental conditions the commonly used 64 alloy is creep limited and not stress-corrosion limited. Cyclic exposures to stress-corrosion conditions are not as detrimental as continuous exposures for equivalent total times. F.R.L.

A72-32142 # Lifting line theory for a wing with a flat plate placed near its tip. K. Moriya. *JSME, Bulletin*, vol. 15, Apr. 1972, p. 466-474; Discussion, p. 474; Author's Closure, p. 474, 475. 8 refs.

In order to obtain the blade characteristics of an axial fan with an orifice-type fan guide, the influence of the fan guide on the blade characteristics is investigated by establishing a theoretical model in which a flat plate parallel to the wing surface is placed near its tip. As the result, a Prandtl-type integral equation for this wing model is derived. In the present paper, the equation is solved when the wing and the plate are in the same plane. Furthermore, the wing planform and its aerodynamic forces satisfying the condition of minimum induced drag are also presented. Thus, the fundamental blade characteristics are clarified concretely. (Author)

A72-32147 # An approximate theory for a jet flap with the wall effect by analogy to a mechanical flap. T. Kida and Y. Miyai (Osaka Prefecture University, Sakai, Osaka, Japan). (*Japan Society for Aeronautical and Space Sciences, General Meeting*, 1st, Japan, Apr. 7, 1970.) *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 14, no. 24, 1971, p. 9-25. 7 refs.

It was suggested by Stratford (1956) that the similarity between the jet flap and the mechanical flap could be exploited to provide a means of calculating the pressure lift induced by the jet. He proposed the criteria of equivalence whereby (1) the aerodynamic lifts on the flaps are to be exactly equal, and (2) the flap angles are to be equal. The amended criteria shown in this paper specify similarity of the drags on the flap and equal induced thrusts at the leading edge. Numerical calculations were carried out for the cases where a jet-flapped airfoil was set in proximity to the ground, beneath a free surface, and in a rigid wall tunnel. (Author)

A72-32182 # Booster abort guidance. V. S. Sohoni (IBM Corp., Huntsville, Ala.). In: *The growth and maturity of navigation in space; Proceedings of the National Space Meeting*, Orlando, Fla., March 15, 16, 1972. Washington, D.C., Institute of Navigation, 1972, p. 48-62. 5 refs.

Discussion of a Booster abort guidance scheme (for critical aborts), from the time of staging until propellant depletion. The guidance scheme is formulated under the following assumptions: (1) instantaneous separation of the Booster and Orbiter vehicles, and (2) all systems of the Booster vehicle are operational with the exception of a possible loss of two out of twelve of the Booster engines. The scheme minimizes the aerodynamic phases during the abort phase and also meets the desired constraints at the Booster cutoff. The scheme is thoroughly evaluated for various abort situations and different landing sites, and the detailed results are included. O.H.

A72-32201 Navigation for general aviation and navigation training; *Proceedings of the National Air Meeting*, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Meeting sponsored by the Institute of Navigation. Washington, D.C., Institute of Navigation, 1972. 113 p. Members, \$10.00; nonmembers, \$15.

Recent developments in navigation techniques and equipment for training purposes and for general aviation applications are described. Topics considered include general aviation requirements for area navigation, use of Doppler systems in area navigation,

provision of intermediate waypoints for inertial equipped aircraft on great circle paths, navigator training simulators, air traffic conflict prediction and resolution, determination of downed-aircraft position, landing and approach systems, and ground mapping radar.

T.M.

A72-32202 # General aviation requirements for RNAV. M. V. Huck (Aircraft Owners and Pilots Association, Washington, D.C.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 1-3.

General aviation RNAV requirements differ from those of other users because of the vast number of flight tracks necessary to serve all airports utilized by this segment of the industry. The present policy of FAA to devise an RNAV airway structure similar to that used in the standard VORTAC system does not take full advantage of the inherent flexibility of area navigation techniques and, if continued, will greatly inhibit the installation of equipment by general aviation users. Introduction of random routing using area navigation will be possible when FAA completes the upgraded third generation ATC system if the automation equipment is programmed to allow control personnel to predict the entry point of a given aircraft in any control sector so ATC planning for separation can take place. Only then will the true potential of RNAV be realized.

(Author)

A72-32203 # Doppler systems applied to area navigation. F. Carpinello and H. Buell (Singer Co., Kearfott Div., Pleasantville, N.Y.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 4-7.

The intent of this paper is to show why and how Doppler navigation equipment is suited to the requirements of R-NAV. The discussion points out the advantages of self-contained Doppler navigation systems such as versatility of routes, continuous velocity vector data for controlled arrival time, and accuracy with little or no need to update. A description is given of an R-NAV system comprised of a particular Doppler velocity sensor with optional navigational computer sets. The presentation of specific equipment relates real, operational hardware to the area navigation problem.

(Author)

A72-32204 # Digital mechanization for single beam Doppler navigation. J. L. Farrell (Westinghouse Electric Corp., Systems Development Div., Baltimore, Md.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 8-14. 9 refs.

With the advent of digital computer-centered integrated avionics, the usual multiple beam Doppler navigator can be replaced by intermittent scanning of a single beam multi-mode radar. An improved avionics mechanization is described for airborne Doppler navigation, augmented by an independent vertical instrumenting channel (accelerometer data combined with barometric information). By taking advantage of optimum statistical data processing methods, the scheme can eliminate most of the voltage controlled oscillator drift effect. Navigation error is then reduced to a level determined by the uncertainty in main beam clutter center frequency, arising from the inherent frequency spread across the antenna beam. Detailed investigation of the estimation algorithm, employing Penrose generalized inverses, demonstrates certain algebraic intricacies which go unnoticed when purely numerical solutions are obtained. (Author)

A72-32205 # Great Circle waypoints for inertial equipped aircraft. R. J. Holm (Litton Industries, Inc., Aero Products Div.,

Woodland Hills, Calif.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 15-26.

Formulation of a method to provide intermediate waypoints on Great Circle tracks for inertial equipped aircraft. By the use of the process it is shown that 24 n mi can be saved on the Great Circle route over Jet Airway 134 (Washington to Los Angeles). The waypoints are for position check with respect to ground radio stations and for prior designation as reporting waypoints. F.R.L.

A72-32206 # R-NAV and TALAR, complementary systems. D. J. Crabtree (Golden West Airlines, Inc., Newport Beach, Calif.) and F. T. Gasper (Singer Co., Kearfott Div., Little Falls, N.J.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 27-37.

This paper describes a hybrid system configuration which yields total enroute and landing navigation capability. The application involves the operations of a commuter airline and their use of modern avionics in a complementary transitioning format. Basic subsystem descriptions and overall system mechanization is described. Operational procedures and usage is given for a typical route structure, with emphasis placed on the transitioning activity. User goals and expectations as well as flight results and accomplishments achieved to date are discussed. (Author)

A72-32207 # Instructional systems development and navigator training. C. E. Walden (USAF, Mather AFB, Calif.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 38-41.

Data interpretation, integration, and systems backup demand, and will continue to demand, a highly trained professional individual in the field of navigation. Producing such an individual requires transfer of knowledge and training. It is Air Training Command's job to provide the relevant knowledge and best possible training at the least possible cost of time and money. The Instructional Systems Development approach is a management tool designed to insure cost-effective achievement of specified objectives. The purpose of this paper is to examine the Instructional Systems Development approach as applied to Air Force Navigator training at Mather AFB, California. Implementation, impact, and problem areas are addressed. (Author)

A72-32208 # Navigation training simulators. M. H. Stephenson and R. L. Feuge (Honeywell, Inc., West Covina, Calif.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 42-51.

Honeywell is currently designing and manufacturing the Undergraduate Navigator Training System (UNTS) for the U.S. Air Force Aeronautical Systems Division and the Air Training Command. This paper describes the design and human factors philosophy of the UNTS, an all-digital trainer that simulates a complete array of air navigation instruments. The discussion emphasizes in particular the training objectives to be met, how the trainer is designed to meet these objectives, and the simulation concepts employed to activate the navigation instruments. (Author)

A72-32209 # Air navigation training in the Canadian Armed Forces. J. Hennessey and A. D. Lee (Department of National Defence, Air Navigation School, Westwin, Manitoba, Canada). In: Navigation for general aviation and navigation training; Proceedings

of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 52-58.

The paper presents the current variety of students and the specific training program designed for them. The primary technique employed in conducting academic, synthetic, and air training is performance oriented. Using lecture response and programmed learning methods, the students are prepared to solve problems. Using synthetic exercises and trainers, the students gradually meet the problems in a more varied combination and in a practical order and time frame. Finally air training is used to demonstrate the validity of problem solutions and to instill self-confidence in the student. The responsibility of the navigator is also instilled early by making the student the sole navigator of the training aircraft. Responsible navigation is a must because operational units expect the graduate to perform immediately with training only in operational requirements and tactics. (Author)

A72-32210 # Navigation training at the USAF Academy. B. T. Parker (U.S. Air Force Academy, Colorado Springs, Colo.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 59-62.

Navigation training at the United States Air Force Academy is unique. The training is directed not only at future Air Force line navigators, but also at future pilots and combat support officers. The courses are designed to acquaint the cadet with the science of navigation rather than to train him to be a navigator. The basic course, Navigation Indoctrination, is the mainstay of the Navigation Division. The course covers basic dead reckoning, map reading, radar, day celestial, weather, airways and instrument flying, and an introduction to advanced techniques and equipment. The Navigation Concepts and Systems Development Course expands on the cadet's basic knowledge and strives to stimulate his mind toward the development and uses of advanced equipment and techniques. Descriptive Astronomy presents the fundamentals of astronomy, properties of the solar system and stellar astronomy. Introduction to Applied Astronomy covers, in the classroom, spherical and stellar astronomy. The course is enriched with laboratory exercises in the Academy's observatory and 50-foot planetarium. (Author)

A72-32211 # Flight simulation for less than \$1,000. J. E. Sidoti (Analog Training Computers, Inc., West Long Branch, N.J.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 63-78.

Discussion of the ATC-510 Personal Flight Simulator, a \$995 equipment which contains all Instrument Flight Rules instrumentation, including audio taped controllers instructions and a turbulence injection device to subject the pilot to additional challenges of difficult flight conditions. The wide simulation flexibility achieved by varying flight assignments and turbulence conditions provides an adequate accommodation to pilots of widely different qualifications. V.Z.

A72-32213 # Air traffic conflict prediction and resolution. H. A. Wachsman (FAA, Washington, D.C.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 83-86.

In a continuing effort to further increase the safety of the National Airspace System, the Federal Aviation Administration is engaged in a broad investigation of collision avoidance techniques which promise the reduction of the mid-air collision threat. The on-going development and evaluation includes air-borne systems

which require avionics installation in aircraft, and ground-based methods which require refinement of existing subsystem capabilities. The development of such a ground-based system was contained in the recommendations of the Air Traffic Control Advisory Committee, and is termed a 'Safety/Separation' Service. The governing factors in the development of the Safety/Separation Service extend beyond the obvious requirement of reliability, to include the ability to interface with the current air traffic control system as well as to integrate into the long-range National Airspace System plan which extends to the end of this century. (Author)

A72-32214 # Locating downed aircraft by GRAN /Global Rescue Alarm Net/. W. R. Crawford and W. E. Rupp, Jr. (U.S. Navy, Naval Air Test Center, Patuxent River, Md.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 87-91.

This paper describes a worldwide distress alarm, identification, and position location system which could be operational within three years. The Global Rescue Alarm Net (GRAN) feasibility tests conducted by the Naval Air Test Center utilized a NASA Omega Position Locating Equipment (OPLE) package modified for UHF operation. Results of low power (ERP) tests with four satellites are discussed. Follow-on tests already funded by a Navy/NASA/Coast Guard joint program to develop system specifications are described. (Author)

A72-32215 # Use of procurement techniques similar to civil avionics in order to reduce military systems' costs. J. S. Gansler (ITT, ITT Avionics Div., Nutley, N.J.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 92-98. 7 refs.

There has been much talk recently about the desirability of using civil avionics procurement techniques in order to reduce the military systems' costs. This paper attempts to quantify some of this discussion. Specifically, it addresses itself to three financial problem areas of military avionics procurement: (1) high acquisition costs, (2) significant program cost growths, and (3) large total costs-of-ownership. This paper suggests further techniques which can be learned from the civil area for greater cost reductions. Particular emphasis is given to cost/reliability design criteria and to warranty to cover follow-on costs. Specific examples of potential overall cost savings on airborne avionics equipment are presented for these recommended cost saving techniques. (Author)

A72-32217 # Outlook for low-cost landing system. F. B. Pogust (Cutler-Hammer, Inc., AIL Div., Farmingdale, N.Y.). In: Navigation for general aviation and navigation training; Proceedings of the National Air Meeting, Atlanta, Ga., Feb. 29-Mar. 2, 1972. Washington, D.C., Institute of Navigation, 1972, p. 102-108.

Discussion of the prospect for replacement of interim landing systems (ILS) with microwave landing systems (MLS) in civil aviation operations. The outlook for a low-cost microwave scanning beam system is believed to be promising. However, only a small number of ground systems of that type are expected to be installed in the near future because of the absence of urgency for replacement. V.Z.

A72-32250 Handbook of airfoil sections for light aircraft. M. S. Rice. Milwaukee, Wis., Aviation Publications, 1971. 138 p. \$3.95.

A broad selection of airfoil section designs is presented, covering major European and North American wind tunnel studies. It is pointed out that many of these airfoil sections are theoretical only

and that less than 20 of them have been utilized in commercially produced light aircraft. Sections are available for all requirements involving high and low speeds, slow landings, high rates of climb, high aircraft gross weight, and long range. G.R.

A72-32319 # R & D pays off for inlet/engine matching. R. Crites, P. Czysz, and F. Lynch (McDonnell Douglas Corp., St. Louis, Mo.). *Astronautics and Aeronautics*, vol. 10, June 1972, p. 64-67.

The inlet duct must supply the engine with proper mass flow and relatively uniform pressure distribution over a wide range of altitudes and Mach numbers. A vast amount of test data has to be considered in connection with the design of the inlet. It has been proposed to digitize the inlet data in order to correlate it with corresponding compressor behavior. An integrated data acquisition and processing system is considered. Problems with an all-digital approach at the present time appear to dictate a thorough exploration of an analog or a hybrid approach. A combination of on-line computations, detection and display at the test site meets the requirements. G.R.

A72-32321 An airports system for United Kingdom air services /19th Mitchell Memorial Lecture/. P. Masfield. *Aeronautical Journal*, vol. 76, May 1972, p. 275-285.

The requirements for accessible, economic, operationally satisfactory, and socially acceptable airports are reviewed, and characteristics of a national airports plan are discussed. Airport categories are specified and confronted with the population areas in the UK and the currently available airports. Based on statistical data, detailed features of the network of future airports in the UK are outlined. O.H.

A72-32322 An end to aircraft noise. L. G. Dawson and T. D. Sills. *Aeronautical Journal*, vol. 76, May 1972, p. 286-293, 296, 297; Discussion, p. 293-295.

The technical feasibility of building a subsonic aircraft and engine combination quiet enough not to annoy the public is discussed. It is demonstrated that, with adequate research and development, it should be feasible to produce a modified version of an RB.211 with a noise standard 9 PNdB lower. Steps are shown by which, with a twin-engined aircraft with the quieter RB.211 engines, the 85-PNdB noise footprint of a 150-200 seat short/medium-range RTOL aircraft can be reduced to 2 sq m. O.H.

A72-32323 Optimal paths for minimising landing transition distance for jet-lift VTOL aircraft. E. Huntley (Sheffield, University, Sheffield, England). *Aeronautical Journal*, vol. 76, May 1972, p. 308-317. 5 refs.

The problem is examined of how should the controls be operated and the flight path chosen in order to bring a jet-lift VTOL aircraft to rest on the ground in an optimum fashion. The approach to this problem is based on an intuitive search for near-optimum solutions by means of physical arguments. Previous Lean's analysis (1966) of the use of incidence control and investigating the optimal choice of transition path is extended. The question is then considered of how to achieve consistent, if suboptimal, control of the transition which, in turn, involves further discussion of control usage. The emphasis throughout is on minimization of transition distance with the immediate aim of minimizing the pilot's problem of judging distance to the hover point. O.H.

A72-32344 # Unsteady viscous flow around an oscillating elliptic aerofoil. A. Okajima, T. Asanuma, and H. Takata. *Tokyo, University, Institute of Space and Aeronautical Science, Bulletin*, vol.

8, Jan. 1972, p. 1-35. 10 refs. In Japanese, with abstract in English.

The unsteady normal force, moment, and surface pressure exerted on an oscillating elliptic aerofoil of 20% thickness ratio are measured over wide ranges of Reynolds number (40 to 20,000), angle of attack (0 to 25 deg), and reduced frequency ($k = 0.1$ to 1.4). A good agreement is found between the results of the present experiment and those of the numerical calculation given in the previous paper. From the viewpoint of the viscous effects of flow, influences of Reynolds number, angle of attack, and reduced frequency on these aerodynamic forces are discussed for the aerofoil which is in either a nonstalled or stalled state. Experimental results are also compared with those of the potential flutter theory for a flat plate or a von Mises profile, those of the modified potential flutter theory proposed by Rott and George, and those predicted by the quasi-steady theory. (Author)

A72-32399 Infrared studies on the jet exhaust of a turbojet aircraft. A. K. Ray and M. R. Katti (Defence Science Laboratory, Delhi, India). *Defence Science Journal*, vol. 21, Oct. 1971, p. 273-282. 11 refs.

In an attempt to evaluate the effective infrared radiant energy from a conical jet exhaust of a jet aircraft, infrared emission characteristics have been worked out with special reference to guidance and decoy purposes. Suitable infrared absorbing materials used for shielding the infrared emitting skin of the radiating part have also been discussed. Attempts have also been made to evaluate the effective radiation on a detecting system after allowing for the solar radiant heat and also atmospheric absorption. (Author)

A72-32427 # TriStar - Structural features. *Aircraft Engineering*, vol. 44, May 1972, p. 4-9.

The primary functional systems of the aircraft include hydraulic, electrical, electronic, environmental control, and auxiliary power systems. Stations are provided for three crew members and two observers. Precise aircraft flight path control is assured by the use of a fully powered flight control system. Handling ease is achieved by four independent hydromechanical systems. Details of the navigation system are considered together with the avionic flight control system, flight instrumentation, the airframe structure, aircraft propulsion, the fuel system, and the cargo and baggage capacity. G.R.

A72-32428 # Development and modifications of the RB 211 engine. *Aircraft Engineering*, vol. 44, May 1972, p. 13-16.

The Rolls-Royce RB 211 three-shaft turbofan engine, rated at 42,000 lb takeoff thrust, is now being delivered in quantity to Lockheed for installation in TriStar airliners. It was recognized that the major source of noise would be the fan. It was, therefore, decided to incorporate a single stage fan without inlet guide vanes, with adequate spacing between fan blade and its outlet guide vanes. A number of development problems are discussed, giving attention to the containment casing for the titanium blades and the reduction of the smoke level. G.R.

A72-32429 # Adhesive bonding of large fuselage panels. *Aircraft Engineering*, vol. 44, May 1972, p. 20-22.

As developed, the TriStar body is a conventional shell construction with a constant cross-section of 235 in. diameter along most of its length. Bonding is utilized throughout the 150 ft of airframe pressurized zone to join doublers and triplers around openings in the skin. Development work conducted between Lockheed and supply firms culminated in the decision that only an epoxy-based material would provide the basic properties capable of meeting the established goals. The various steps required in the bonding process are discussed. G.R.

A72-32430 # Maintenance of the 747. Aircraft Engineering, vol. 44, May 1972, p. 23-25.

The Boeing 747 maintenance program, as approved by the Federal Aviation Administration Maintenance Review Board, was a major advance for new aircraft maintenance programs. The acceptance of condition monitoring and threshold levels for engine inspections contained within this program provided key starting points for further advances in maintenance technology. The JT9D engine performance monitoring was developed into a computer program which takes engine cruise parameter readings, converts them into standard day conditions, and prints a daily graph for each engine.

G.R.

A72-32451 Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 205 p.

The papers deal with management of short-haul airlines to ensure on-time operations, time schedules in a military environment, airport problems affecting on time operations, and air traffic control with reference to system coordination. Some of the current activities by which product support can help operators to minimize delays are reviewed. The design approach to maintainability of Concorde engines, the role of the management information system, and the influence of airframe design on availability are discussed. An attempt is made to review the total management problem of staying on time with the Concorde.

F.R.L.

A72-32452 # Managing - Short-haul airlines - To be on time. J. Garton (British European Airways Corp., Ruislip, Middx., England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 21 p.

Identification of the problem sectors of a typical short haul, classical hub and spoke type operator (BEA). Their size in quantity and cost are stated and briefly examined. Major attention is focused on the technical reliability sector problem, with statement of the factors, mechanical and human, of the punctuality equation. The technical, operational, and financial management systems, and the staff training and development programs are defined. The day to day control of front-line activities is given in terms of organization, communications, and unserviceability control. Some of the technical problems which would yield to concentrated effort are studied.

F.R.L.

A72-32453 # Time in a military environment. P. C. Cleaver. In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 19 p.

Review of the time parameter in its many contexts over the whole spectrum of military operations ranging from transport through maritime reconnaissance, strike, ground attack and air defence operations to the day-to-day problems of operating training aircraft in the confined and busy airspace over the UK. Particular problem areas are highlighted where appropriate. Among the major problems, however, is the economic state of the country which, to some extent, controls national defence policy.

F.R.L.

A72-32454 # Managing to be on time - Airport problems. N. J. Payne (British Airports Authority, London, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings.

London, Royal Aeronautical Society, 1972. 11 p.

Study of the importance of total journey time to air passengers and cargo, the times currently spent at airports by air passengers and cargo, airport planning concepts to save passenger time on the ground, and the interaction of time, capacity, congestion, and cost, which summarizes most airport problems. Changes in total time have had marked effects on traffic growth. On average, departing air passengers spend over an hour in the airport terminals, of which less than 10 minutes are spent on essential operations.

F.R.L.

A72-32455 # Air traffic control - The system, the problems and the possibilities. R. E. Cox (National Air Traffic Services, London, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 17 p.

Discussion of the duties of the National Air Traffic Services (NATS) to encourage measures which raise the potential of the airspace, such as the more competent use of better navigation systems. Constraints which arise from conflicts of interest, adjacent ATC systems, human factors, electronic system limitations, implementation time cycles, and system reliability are considered. Various navigation systems are discussed, and attention is given to all-weather operations, ground and air-to-ground communications, radar, and data processing.

F.R.L.

A72-32456 # Managing to be on time - What industry can do to help - The role of product support. R. H. Botterill (British Aircraft Corp., Ltd., London, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 13 p.

Review of some of the current activities by which product support can help operators to minimize delays either by direct action in flight or during turnaround at the ramp, or indirectly through supporting services. Emphasis is placed on fault isolation and reporting both in flight and during aircraft turnaround and despatch.

F.R.L.

A72-32457 # The design approach to maintainability of Concorde engines. L. S. Snell (Rolls-Royce, Ltd., London, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 17 p. 5 refs.

Consideration of the Concorde turbine engine proper, discussing the design approach to certain aspects of engine maintenance aimed at increased overall reliability and decreased turnaround time. Concorde engines are robust and relatively simple, e.g., there are only two turbine stages. Throughout the design care has been taken to ensure that no misassembly is feasible. Diagnostic facilities are described in detail. On-wing maintenance was one of the most pressing considerations in the design.

F.R.L.

A72-32458 # Managing to be on time - The role of the management information system. R. Morris. In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings. London, Royal Aeronautical Society, 1972. 15 p.

Discussion of the management information system, which provides the 'adaptive' part of an adaptive control system which enables management to choose the hardware which needs to be

adjusted by modification or replacement, to adjust and adapt the human resources, and to modify the communications systems themselves so that performance can be improved. The principles of the RAF system, described in detail, involve (a) a unified system, standardized throughout the service, based on a single design document (the job card), and (b) the elimination of transcription. The man who originates the card creates a copy for the data center, although this is supplemented by subsequent coding processes. F.R.L.

A72-32459 # Influence of airframe design on availability. S. C. Calindi (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings.

London, Royal Aeronautical Society, 1972. 38 p.

Review of the field of aircraft operational reliability from the standpoint of the aircraft designer. Advances have been made in understanding the nature of the problems contributing to unreliability which in turn should lead to significant improvements in design. It is emphasized that no one party working in isolation can produce a satisfactory solution. The way of future progress lies in the full exploitation of the working relationships between component supplier, aircraft manufacturer, and operator, working together from the earliest stages in design until all are satisfied that no further improvement can be economically justified. F.R.L.

A72-32460 # Concorde - Timesaver. E. H. Burgess and W. A. N. Ford (British Aircraft Corp., Ltd., London, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings.

London, Royal Aeronautical Society, 1972. 18 p.

Attempt to review the total management problem of staying on time with the Concorde. Considerable benefits have been derived from a close relationship between the potential operators and the designers. From the start of the design phase of Concorde it was the intention that, as far as possible, the aircraft should not require special treatment at the airports. The necessarily long undercarriage of the Concorde makes for some accessibility problems. The narrow fuselage entails reduced volume available for systems. Techniques are being developed for the diagnosis and onward reporting of in-flight failures. Attention is given to operations, scheduling flexibility, and arrival reliability. F.R.L.

A72-32461 # The influence of avionic equipment of aircraft timekeeping. R. W. Howard (GEC-Marconi Electronics, Ltd., Chelmsford, Essex, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings.

London, Royal Aeronautical Society, 1972. 19 p.

Search for possible improvements in airline timekeeping which could result from the avionics aspects by dividing the study into two major parts: in-flight operations, and aircraft unserviceability. Avionics will affect mainly the categories of weather (10%), technical and engineering (15%) and air traffic (5%). Other causes account for the remaining 70%. An all-weather landing capability should remove most of the weather delays, and the additional equipment involved should not increase the level of delays in the technical and engineering categories if the operation of the all-weather system is not 'dispatch critical.' It appears that total improvement in delays of up to 15% might be the aim for aircraft in current service if it is accepted that the proposed electronic additions are not 'dispatch critical.' In the future, fly-by-wire, CCV (Control Configured Vehicle) requirements and scheduled all weather landing will demand a change in emphasis and such elements will become 'dispatch critical.' F.R.L.

A72-32462 # 'I have a device to make all well' - Or have I. C. D. Colchester (Marconi Co., Ltd., Chelmsford, Essex, England). In: Managing to be on time: A total system approach in aircraft operations; Royal Aeronautical Society, Spring Convention, London, England, May 10, 11, 1972, Proceedings.

London, Royal Aeronautical Society, 1972. 6 p.

Discussion of the problems that arise and interfere with on-time operation of aircraft. It is pointed out that the proliferation of inventiveness has led to so many potential solutions to air traffic problems, and to so many devices intended to solve them, that difficult decisions must be made on which should be adopted. It appears that operators, nations, and manufacturers frequently present ideas which, if adopted, would be incompatible with existing systems, or might be incompatible with superior future systems. F.R.L.

A72-32571 # Interaction of electromagnetic radiation with an airplane. H. T. Chang (EG & G, Inc., Albuquerque, N. Mex.). In: Purdue Symposium on Electromagnetic Hazards, Pollution and Environmental Quality, Lafayette, Ind., May 8, 9, 1972, Proceedings.

Lafayette, Ind., Purdue University, 1972. p.

109-119. 8 refs.

A study is made of the penetration of electromagnetic waves through a conducting gasket used to protect sensitive devices in an airplane. The radius of the hatch is assumed to be very small as compared to the wavelength. The penetrated field is shown to be caused by the induced current on the gasket; a quasi-static solution is given, satisfying the boundary conditions. On a plane close to the hatch, the highest penetrated fields occur directly below the gasket ring. The maximum fields lie on a diameter parallel to the tangential component of the incident magnetic field. It was found that the field strength decreases for more than 10 dB at one radius away from the gasket. The overall shielding effectiveness indicates a range of 20 to 90 dB for various thickness and conductivities of the gasket.

(Author)

A72-32610 # Current predictive models of the dynamic environment of transportation. J. T. Foley, M. B. Gens, and C. F. Magnuson (Sandia Laboratories, Albuquerque, N. Mex.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings.

Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 162-171. 31 refs. AEC-supported research.

This paper describes the current predictive models of the transportation dynamic environment which have been developed for use by Sandia Laboratories. The information sources, methods of building the models, and the method of representation are described. Advantages and limitations of the models are discussed. Suggestions are given for further work to improve the models. (Author)

A72-32612 # Environmental control system for the F-111 low temperature proof load chamber. K. W. Monroe and W. F. Mac Swain (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings.

Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 207-214.

The conduction of proof-load tests at -40 F required a unique environmental control system in order to temperature-condition an entire aircraft before, during, and after the proof test. The system used to meet the specified requirements is considered. Test requirements are discussed together with system details, giving attention to enclosure, refrigeration, heating, oxygen monitors, system controls, and accessory equipment. The environmental control system discussed made possible the early start of testing and has supported the rapid return of the F-111 aircraft to the Air Force inventory. G.R.

A72-32614 # The evolving regulatory structure of environmental noise abatement and control. L. H. Mayo and R. C. Ware (George Washington University, Washington, D.C.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 226-234. 16 refs.

The vast variety of noise sources and the basic options of abatement at the source, reduction of noise effects, or compensation for harm resulting from noise present a challenging regulatory task since choices for controlling noise in the various noise environments must be made from among a great diversity of alternative abatement strategies. Aspects of environmental noise abatement and control through private actions are discussed together with the governmental regulatory framework, the present status of regulatory efforts, and trends in noise regulation. G.R.

A72-32620 # The Aircraft Catapult Simulator. R. J. Rothaug and F. E. Gerber (Dayton T. Brown, Inc., Bohemia, N.Y.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 322-325.

It is pointed out that the arrested landing and catapult launch tests stipulated in MIL-T-7743D do not assure that store suspension equipment will meet fleet operating conditions, mainly because no facility short of an actual catapult has been available that simulates these environments. An Aircraft Catapult Simulator was designed, built, and tested in order to correct the situation. The new device simulates the physical forces associated with catapulted launches and arrested landing of an aircraft during carrier borne operation. G.R.

A72-32621 # Effect of high-intensity sound on electronic equipment and components. W. Fricke and M. V. Barsottelli (Bell Aerospace Co., Buffalo, N.Y.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 326-331. 10 refs.

Survey of literature on the effects of high-intensity sound on electronic equipment and components. Such effects must be considered when obtaining requirements of sound-proofing against intense noise fields, such as those of aircraft. A compilation of the results from noise testing of components shows that resistors, capacitors, and transistors represent the sound-insensitive category, in general. Vacuum tubes, gyros, baroswitches and relays experience detrimental changes in output when exposed to high-intensity noise or acoustically excited vibration, and are therefore classified as sound-sensitive. In particular, whisker diodes and printed circuit boards can experience irreversible damage. D.F.L.

A72-32625 # Dynamic environment study of turbojet cargo aircraft. C. F. Magnuson (Sandia Laboratories, Albuquerque, N. Mex.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 420-425. 6 refs. AEC-supported research.

The purpose of the study was to determine the dynamic input to cargo from the cargo floor in turbojet aircraft. Data were obtained during two flights on C141 aircraft and one flight on a C5A. The instrumentation, test procedures, data reduction processes, and results are discussed. The vibration of turbojet aircraft is shown to consist of near-Gaussian, wide-band random excitation with superimposed near-constant-amplitude, narrow-band 'spikes' at frequencies apparently associated with turbine imbalance, turbine airflow, and local structural natural frequencies. (Author)

A72-32631 The future of electronic displays; Proceedings of the Joint Symposium, London, England, February 23, 1972. Symposium sponsored by the Royal Aeronautical Society and Institution of Electrical Engineers. London, Royal Aeronautical Society, 1972. 47 p.

Human factor problems involved in electronic displays (ED), ED use in modern navigator-attack systems, and the views of civil helicopter pilots on ED merits are among the topics covered in papers concerned with electronic displays for military and civil aircraft. Other contributions include an appraisal of the inherent advantages and disadvantages of electronic displays and a discussion of their role in future avionics systems.

M.V.E.

A72-32632 # Electronic displays - Precision tools for the pilot. B. J. Calvert (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). In: The future of electronic displays; Proceedings of the Joint Symposium, London, England, February 23, 1972. London, Royal Aeronautical Society, 1972. 3 p.

The trend toward smaller crews in smaller spaces needing larger amounts of data for more precise control of their aircraft in tasks of increasing complexity is discussed, along with the entailed need to limit at every moment the display of processed, concentrated, and selected data to those that are relevant to the task at hand. Electronic displays are expected to help meet this need, though the clarity, stability, and readability of cathode-ray tube images in cockpits are felt to need ascertainment. M.V.E.

A72-32633 # Electronic displays - Civil helicopter pilot's view. R. Williams (BEA Helicopters, Ltd., Gatwick Airport, Surrey, England). In: The future of electronic displays; Proceedings of the Joint Symposium, London, England, February 23, 1972. London, Royal Aeronautical Society, 1972. 7 p.

Information display requirements on helicopters are contrasted with those on fixed-wing aircraft, and the requirement divergences are traced to basic differences in the nature and operation of the two classes of aircraft. Interesting helicopter applications of electronic display techniques are believed possible, but contingent on thorough development efforts. M.V.E.

A72-32634 # The use of electronic displays in modern NAV/attack systems. D. E. Humphries and M. Treadgold (Royal Aircraft Establishment, Farnborough, Hants., England). In: The future of electronic displays; Proceedings of the Joint Symposium, London, England, February 23, 1972. London, Royal Aeronautical Society, 1972. 9 p.

Review of the role electronic displays play in lowering the workload of the operator to an acceptable level, and discussion of the way in which they contribute to the capability of a complete navigator-attack system. Because of the diversity of sensors used in a modern attack aircraft, each of which has a specific contribution to make to the overall effectiveness of the system, flexible electronic displays are essential if the crew are to keep abreast of rapid developments, and if they are to use their sensors to best advantage. M.V.E.

A72-32635 # The role of electronic displays in future avionic systems. W. H. McKinlay, J. M. Braid, and M. A. V. Matthews (Ferranti, Ltd., Hollinwood, Lancs., England). In: The future of electronic displays; Proceedings of the Joint Symposium, London, England, February 23, 1972. London, Royal Aeronautical Society, 1972. 13 p.

Discussion of the state of art, and of present and future trends in electronic displays, and assessment of their expansion potential in avionics systems. An effort is made to achieve a perspective in which electronic display technology is related to other technologies which

have a bearing on its adoption in real systems. Special attention is given to computer driven displays, or displays used in systems based on digital data exchange. M.V.E.

A72-32636 # Electronic displays - Wanted or wanting. R. A. Chorley (Smiths Industries, Ltd., Wembley, Middx., England). In: *The future of electronic displays; Proceedings of the Joint Symposium, London, England, February 23, 1972.* London, Royal Aeronautical Society, 1972. 8 p.

Discussion of some of the problems encountered when the adoption of electronic displays as part of a total aircraft display system is pondered. These problems are weighed against the distinctly attractive properties these displays possess. Only cathode ray tube displays are considered. M.V.E.

A72-32826 # Three-dimensional flow separations on aircraft and missiles. D. J. Peake, W. J. Rainbird, and E. G. Atraghji (National Aeronautical Establishment, Ottawa, Canada). *AIAA Journal*, vol. 10, May 1972, p. 567-580. 63 refs.

Some three-dimensional boundary-layer flow configurations for which a good understanding of the viscous flow is available are described by examples of three-dimensional separations on slender bodies, delta wings, boundary-layer diversion systems, and propulsion intake areas. Available techniques for computing interfering inviscid flowfields are reviewed, and numerous graphs and flow visualization photos illustrate flow patterns, pressure distributions, separation lines, critical angles of incidence for separation, heat transfer distributions, and effects of diverters. T.M.

A72-32827 # Jet-flapped wings in very close proximity to the ground. T. Kida and Y. Miyai (Osaka Prefecture, University, Sakai, Osaka, Japan). *AIAA Journal*, vol. 10, May 1972, p. 611-616. 14 refs.

The method of matched asymptotic expansions is applied to the problem of jet-flapped wings of finite span in very close proximity to the ground. For the linearization of this problem, the order of small parameters, the angle of attack and jet deflection, are assumed to be smaller than the ratio of the ground clearance to the root chord. This linearized problem is solved as a direct problem represented by a source distribution on the upper surface of the wing and jet sheet with concentrated sources around the leading and side edges plus a separate confined channel flow region under the wing and jet sheet. The two-dimensional, jet-flapped airfoil is examined in detail, and the calculated lift coefficients lie within 5% of corresponding results by Lissaman (1967). In the three-dimensional case, a simple analytic solution is obtained for a flat plate semielliptic wing with a straight trailing edge, zero angle of attack and uniform momentum distribution of the jet. Spanwise lift distributions and lift coefficients are derived and the distributions of the jet momentum are discussed for minimum induced drag. (Author)

A72-32885 # Determination of noise exposure around an airport. J. Igarashi and G. Nishinomiya (Japan Broadcasting Corp., Tokyo, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report no. 476*, vol. 37, Mar. 1972, p. 53-69. 9 refs.

This paper presents a study of the noise exposure contour around an airport. The contour was figured out from the measured data obtained in the vicinity of Osaka Airport. It is compared with the calculated contour based on the data of FAA, the specified flight paths, and scheduled operations similar to those of the period of measurements. The methods of determination of PNdB, duration, and tone corrections are also mentioned, together with the relation between PNdB and dB(D) or dB(A). (Author)

A72-32886 # A free-flight support system. A. Azuma, M. Iuchi (Tokyo, University, Tokyo, Japan), B. Tomita (National Space Development Agency of Japan, Tokyo, Japan), H. Mishima, T. Iwata, and A. Komoto (Shimadzu Seisakusho, Ltd., Kyoto, Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report no. 477*, vol. 37, Mar. 1972, p. 71-104. 6 refs.

A support system for free flight of V/STOL or helicopter models is described. The support system consists of a free-flight follower and a data reduction system. The free-flight follower rests on a carriage moving on a track and supports the model in free or partly constrained flight. The flight path and attitude angles of the model during flight can be sensed with potentiometers on the support system and are recorded in oscillograms or stored in memories of a miniature computer through an A-D converter. (Author)

A72-32895 STRADA landing trajectory recording system (Le système de trajectographie d'atterrissage STRADA). J.-P. Marvillet (Direction des Recherches et Moyens d'Essais, Service des Equipements de Champs de Tir, France) and J.-L. Jouzeau (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique*, no. 35, 1972, p. 19-29. 6 refs. In French.

Developed by SECT to cover the needs of the CEV, the STRADA system should give an accurate real-time restitution of the flight path of planes during the approach and landing periods and should allow in this way the development and certification of automatic landing systems. Using the recently developed optronic techniques and the possibilities made available by the real-time computer incorporated in a measuring unit, the system consists basically of a laser radar (LIDAR) reproducing not only the distance but also the angular coordinates of a passive optical reflector the sole special device to be installed on the aircraft. Following a recall of the required performance and a general description of the STRADA system, a detailed study of the LIDAR components (turret, laser transmitter, deviation measuring receivers and telemetering), of the way of processing the data received from the LIDAR and of the function assigned to the computer is presented. It is shown how problems related to system reliability and to propagation in the atmospheric medium were solved. In conclusion, the performance and the fields of application of this optimized test facility as regards cost, efficiency and ease of operation are considered. (Author)

A72-32897 Thermal tests on aerospace structures and materials (Essais thermiques sur structures et matériaux aérospatiaux). B. Sarrette (Société Nationale Industrielle Aérospatiale, Paris, France). *L'Aéronautique et l'Astronautique*, no. 35, 1972, p. 45-52. In French.

Review of the methods and means currently employed in simulating kinetic heating of aerospace vehicles. After a brief summary of the causes of heating of aerospace vehicles and of the resulting problems a detailed account is given of the manner in which experimentation is conducted in this field. The parameters to be simulated and the simulation facilities employed are described for different types of missions ranging from supersonic flight to atmospheric reentry. A.B.K.

A72-32898 A wind tunnel for the study of subsonic flows with a periodically varying speed (Soufflerie pour l'étude des écoulements subsoniques à vitesse périodiquement variable). M. Plan, J.-M. Thomas, H. Mainardi, and S. Burnel (Orléans, Université, Orléans, France). *L'Aéronautique et l'Astronautique*, no. 35, 1972, p. 53-59. In French.

Description of a subsonic wind tunnel which produces a pulsed flow whose speed modulation law is a periodic function of time. The theoretical principle of this wind tunnel is outlined, and the structure of the wind tunnel is described in detail. The improvements obtained in comparison with conventional devices which achieve speed

modulation through periodically varying pressure losses are indicated. The results of initial tests carried out in the new wind tunnel are summarized.

A.B.K.

A72-32899 Optimization of structures by simulation (Optimisation des structures par simulation). J. J. Audy (Société Nationale Industrielle Aérospatiale, Paris, France). *L'Aéronautique et l'Astronautique*, no. 35, 1972, p. 64-67. In French.

Brief description of an analog method of simulation developed for highly redundant structures. The proposed method is based on the electrical simulation of the structure under study, reproducing the mechanical behavior of the structure in stabilized stress states. The structure model studied is assumed to be multicellular with direct physical correspondence between each mechanical cell and the ensemble of corresponding electrical elements. The results of application of the method to the design of the Concorde SST are cited.

A.B.K.

A72-32900 # Aerodynamic and structural noise research at NAE. R. Westley, G. M. Lindberg, Y. Y. Chan, and B. H. K. Lee (National Aeronautical Establishment, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin*, no. 1, 1972, p. 1-21. 43 refs.

Outline of current and proposed noise research programs encompassing a wide range of unsteady high-speed aerodynamic processes and structural response problems. Results obtained to date are briefly summarized for studies involving turbulent shear noise, shear wave instability and Mach wave radiation, wave amplification due to sound wave and jet interaction, shock cell noise, finite amplitude sound waves, jet flows in moving media, wind tunnel noise, V/STOL noise, effects of trailing vortices, atmospheric transmission patterns, and the response of stiffened panels to noise. Flow visualization photos illustrate noise propagation phenomena, and oscillograms show spectral response characteristics of panel sections.

T.M.

A72-32901 # Experimental investigation of three-dimensional turbulent boundary-layer developing in a compressor cascade passage. C. L. Wakhaloo (Government Engineering College, Rewa, India). *Aeronautical Society of India, Journal*, vol. 24, Feb. 1972, p. 221-230. 26 refs. Research supported by the University of Liverpool.

Experimental-investigation of a three-dimensional turbulent boundary-layer generated on the end wall of an axial flow compressor cascade passage. The boundary layer developed under an adverse pressure gradient. Measurements were carried out in the region away from the corners formed by the blades resting on the end wall. Semilogarithmic plots of the velocity profiles in the external streamline direction exhibit a good agreement with the law of the wall. In the case of a well developed layer a wake function quite in agreement with that suggested by Coles (1956) is obtained; values of Coles' parameter exceed unity. The cross flows are not so strong. A change in the direction of transverse pressure gradient gives rise to points of inflection in the external streamlines, and 'S' shaped cross flow velocity profiles occur. Upstream and downstream of the points of inflection cross flow velocities have opposite directions.

(Author)

A72-32908 # Coupled bending bending torsion vibrations of cantilever beams. J. S. Rao (Indian Institute of Technology, Kharagpur, India). *Aeronautical Society of India, Journal*, vol. 24, Feb. 1972, p. 265-268. 10 refs.

The collocation method is used to study the coupled bending-bending torsion vibrations of a straight uniform cantilever beam with

asymmetric aerofoil cross section. Numerical results, which are based upon a solution of the differential equations, are compared with the Galerkin process. The simplicity of the collocation method over energy methods, such as the Ritz or Galerkin processes, indicates that it would be a powerful tool in the solution of turbine blade vibration problems.

D.F.L.

A72-33010 * Non-asymptotic effects in the approach to the far field sonic boom. L. F. Henderson (Cornell University, Ithaca, N.Y.). *Zeitschrift für angewandte Mathematik und Physik*, vol. 22, Nov. 25, 1971, p. 1103-1125. 9 refs. Grant No. NGL-33-010-057.

An extension is described for the Whitham theory (1952, 1954) which indicates small deviations from the ultimate N-wave for bodies with a continuous or discontinuous tangent. Some simple formulas are derived which yield a good reduction in the sonic boom intensity. The theory is elucidated by some numerical examples for a class of simple theoretically relevant shapes.

O.H.

A72-33048 VFW-Fokker's latest VTOL transport designs. I (Neue VTOL-Transportflugzeug-Entwürfe von VFW-Fokker. I). M. Lichte (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Flug Revue/Flugwelt International*, June 1972, p. 43-46, 51-54. In German.

The design specifications for the new aircraft are discussed, giving attention to the payload, the range, the runway conditions, noise, and military capabilities. Aspects of project definition are considered, taking into account fixed engine installation, retractable engines, the VC 180, and the VC 181. Questions of operational expenses and economics are also examined. A new computational approach for the determination of the operational expenses of transport aircraft had to be developed because standard procedures for conventional aircraft did not provide realistic data for the VTOL operations.

G.R.

A72-33049 V/STOL weapon system VJ-101 - One-axis rocking device and suspension structure. III (V/STOL-Waffensystem VJ-101 - Einachsen-Wippe und Schwebegestell. III). H. Redemann. *Flug Revue/Flugwelt International*, June 1972, p. 66-68. In German.

It had been decided to build two purely experimental aircraft. An approach involving control with the aid of thrust changes during the hovering flight phase was considered for the VJ-101C design. Tests with a one-axis rocking device were conducted in order to obtain some practical experience for the new approach. A suspension structure was used for studies regarding the interaction of the axes in hovering flight.

G.R.

A72-33113 A plan for ultra-short-haul air transportation. R. H. Miller (MIT, Cambridge, Mass.). *Technology Review*, vol. 74, June 1972, p. 22-31.

Ultrashort-haul travel, characterized by trip lengths of less than 50 miles, represents the single largest block of travel in the U.S. and is currently dominated by the automobile. It is shown that the technology of VTOL aircraft has advanced to a point where a satisfactory common-carrier air transportation system based on these vehicles may be economically viable for suburban-to-city center trips of 10 to 50 miles. Studies of a hypothetical air transport system indicate advantages of rapid access to presently congested areas at costs competitive with land-based transport. Improvements in aircraft engineering minimize problems of noise pollution, exhaust emission, dispatch reliability, and safety.

T.M.

A72-33174 Handling intermodal and interline containers. G. V. Schultz. In: *International Forum for Air Cargo*, 6th, Washington, D.C., May 31-June 2, 1972, Proceedings. New York,

Society of Automotive Engineers, Inc., 1972, p. 23-32.

Usage of intermodal and interline freight containers is traced throughout the entire distribution system including warehouse storage, interfacing of different transportation modes, and distribution to local users. Emphasis is placed on the Total Pack system of intermodal unit loads and modular packaging dimensions. Package engineering considerations are examined with respect to desired aspect ratios and interlock requirements. Reasons are presented for adoption of a 54 by 45 in. intermodal unit load in the air cargo mode. T.M.

A72-33175 Terminal handling environment for noncontainerized freight. E. A. LaMarre (United Air Lines, Inc., Chicago, Ill.). In: International Forum for Air Cargo, 6th, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 33-37.

The importance of noncontainerized freight shipments to the air cargo industry is delineated, and specialized requirements posed by these shipments at terminal facilities are offered as an argument against the imposition of stringent uniform operating conditions at individual terminal stations. Handling procedures employed for security freight, live animals, perishables, and some types of nonperishable (hard) freight illustrate how terminals are individually keyed to the needs of their local shippers. The presently available degree of flexibility is shown to be necessary in responding to the needs of special local customers. T.M.

A72-33180 Intersociety Conference on Transportation, Washington, D.C., May 31-June 2, 1972, Proceedings. Conference sponsored by the Society of Automotive Engineers, American Institute of Aeronautics and Astronautics, American Institute of Industrial Engineers, American Society of Mechanical Engineers, Engineering Institute of Canada, Institute of Electrical and Electronics Engineers, and Operations Research Society of America. New York, Society of Automotive Engineers, Inc., 1972. 269 p. Members, \$18.75; nonmembers, \$25.

Passenger and cargo transportation systems are examined in a series of papers dealing with planning and forecasting procedures, special problems encountered in high-density urban areas, efficient linkage of different forms of transport at terminal areas, VTOL short-haul operations, and control measures in the transportation industry. The unique capabilities of heavy-lift helicopters in solving difficult transportation and construction problems are demonstrated along with potential applications of flexible wings in transport and emergency situations. The economic feasibility of VTOL transit between suburbs and central city areas is seen as a possible solution to heavy automobile traffic in congested regions. T.M.

A72-33181 A status report on VTOL short-haul systems. M. W. Hellyar (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Intersociety Conference on Transportation, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 229-236.

This paper traces the evolution of the VTOL short-haul concept from its origins in 1967 to the present. It shows how design proposals have become more responsive to the evolving system and economic requirements of the potential operating airlines. For example, Sikorsky is preparing a two-phase program beginning with the readily available 46-passenger S-65-40 helicopter, and followed by introduction of the 100-passenger S-200 compound aircraft in 1980. The VTOL market potential is discussed, as is projected acceptance of the VTOL short-haul system in the Northeast Corridor and the principal routes of western Europe. (Author)

A72-33182 * Flexible wings for transportation. F. M. Rogallo, D. R. Croom, and W. C. Sleeman, Jr. (NASA, Langley Research Center, Hampton, Va.). In: Intersociety Conference on Transportation, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 237-247. 115 refs.

The possible uses of flexible wings for transportation of passengers and cargo from point to point on earth are discussed along with emergency applications of flexible wings in connection with conventional aircraft. Topics considered include gliding and soaring as a sport, towing of flexible-wing gliders for cargo delivery, powered flight with small aircraft having folding flexible wings, aerial dropping of personnel and cargo on flexible wings instead of parachutes, landing and recovery of rocket payloads by means of flexible wings, and use of flexible wings with ejection seats and as an emergency landing system for conventional aircraft. T.M.

A72-33183 * Some applications of buoyancy systems and parawings to replace conventional and proposed transportation systems. C. D. Havill and L. J. Williams (NASA, Washington, D.C.). In: Intersociety Conference on Transportation, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 248-254. 10 refs.

An exploratory study has been conducted to assess the performance potential of buoyant airships and parawings in short-haul passenger transportation. Results show that such systems can be used effectively, from a performance standpoint, in a VTOL or STOL mode of operation. A supplementary assessment of potential applications of such vehicles is examined, with a brief look at economic factors and an examination of missions for which they might be effectively used. (Author)

A72-33184 Civil applications of the air cushion landing system. D. H. Grupe (Bell Aerospace Co., Buffalo, N.Y.). In: Intersociety Conference on Transportation, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 255-259. 5 refs.

This paper will provide a brief history of the development of the air cushion landing system, including the present U.S. Air Force/Canadian Department of Industry, Trade, and Commerce advanced development program to equip a DeHavilland CC-115 Buffalo airplane with an air cushion landing system. The operation, braking, and parking of the air cushion landing system will be explained. The advantages of this type of landing system over conventional wheeled landing gear will be examined in relation to civil aircraft applications such as high density, low density short haul transportation systems, and STOL operations. The effect of ACLS on airport design, safety, environmental factors, and potential weight saving will be discussed. It is concluded that the development of the ACLS is an aeronautical technology that will result in a benefit to civil aircraft transportation. (Author)

A72-33185 The role of the heavy lift helicopter. E. E. Gustafson (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Intersociety Conference on Transportation, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 260-265.

Current and anticipated applications of the S-64 Skycrane helicopter in commerce and industry are described to illustrate its unique potential of solving difficult transportation and construction problems. Examples considered include logging operations in ecologically sensitive or rugged areas, bridge construction, dike building, transfer of cargo to building rooftops, transport and erection of towers for electric powerlines, supply and delivery to remote oil drilling operations, ship-to-shore transfer of cargo, and delivery of prefabricated housing units. T.M.

A72-33221 The challenge for new structural test methods. K. C. Mard (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *Materials Research and Standards*, vol. 12, June 1972, p. 21-25, 55, 56.

The helicopter manufacturer is being motivated to reduce the cost of testing by employing new test methods. To meet this challenge at Sikorsky Aircraft, a comprehensive effort is being made to seek out activities that are unnecessarily costly and to stimulate ideas for minimizing these costs. Several examples of cost-saving techniques are given, including an analytical method for establishing replacement times of components subjected to fatigue, finding alternatives to constraints on testing such as that caused by weather, use of simulated system tests, use of computer hardware to expedite test engineering evaluation and decisioning, and effective control of data quality and quantity requirements. Significant cost and calendar time savings are projected for major development programs. (Author)

A72-33229 # Studies on the gust response of a wing. II. H. Maeda (Kyoto University, Kyoto, Japan) and M. Kobayakawa (Kansai University, Osaka, Japan). *Kyoto University, Faculty of Engineering, Memoirs*, vol. 33, Oct. 1971, p. 343-367, 5 refs.

The deformations of a two-dimensional elastic wing caused by gusts were separated into two types connected with the bending mode and the torsional mode. The gusts investigated include the sinusoidal gust and the random gust. In the case of a sinusoidal gust, the modes of deformation were studied both theoretically and experimentally. In the case of the random gust, the power spectral functions and the frequency transfer functions were obtained experimentally. The frequency transfer functions obtained by theoretical calculations were compared with the experimental values.

G.R.

A72-33244 Digital attitude and heading reference system. D. R. Brickner (Sperry Rand Corp., Sperry Flight Systems Div., Phoenix, Ariz.). *Sperry Rand Engineering Review*, vol. 24, no. 4, 1971, p. 23-27.

Description of a new all-attitude attitude and heading reference system (AHRS) which makes use of solid-state techniques in the data format conversion and the heading control functions. The AHRS computer is a 16-bit parallel organization utilizing 16 general registers in a two's complement arithmetic processor. The AHRS computer including all input/output and memory functions is packaged on four multilayer printed circuit boards. The computer consumes approximately 35 watts of power, utilizes 43 cubic inches, and weighs 1.8 pounds. The computer provides heading and attitude angles in digital form, gyroscopic erection control, and heading slaving control. The AHRS program is completely executed 75 times per second. Roll data are updated 300 times per second with pitch and heading updates at 75 times per second.

A.B.K.

A72-33245 Avionics computer for ASW. W. D. Marth and E. F. Melin (Sperry Rand Corp., Univac Div., St. Paul, Minn.). *Sperry Rand Engineering Review*, vol. 24, no. 4, 1971, p. 28-34.

Description of a multiprocessor computer designed to meet the extremely high data processing requirements of airborne antisubmarine warfare (ASW). The Univac 1832 computer is composed of two central processors, two input/output controllers (IOCs), two input/output interfaces (IOIs), two 32,000-word memory units, a power supply, and space for an additional 32,000-word memory unit. The computer's electronics include integrated circuit flatpacks and high-density medium-scale integrated circuits that meet military requirements. Logic cards and power converters are housed in easily maintainable drawer units. The computer's random access memory is also packaged in drawers. The central processors are capable of handling both fixed- and floating-point arithmetic. The most important functional feature of the 1832 computer is its shared memory. Each memory bank has accessing ports for six user units. Each IOI connects to both IOCs and provides the controllers with

their external interface. Each IOC operates independently of the other and interfaces with each processor and memory bank, allowing the IOC to be initiated and controlled by either processor and to access to any memory bank.

A.B.K.

A72-33246 Loran-inertial data processing. G. C. Erkmann and S. G. Rogich (Sperry Rand Corp., Great Neck, N.Y.). *Sperry Rand Engineering Review*, vol. 24, no. 4, 1971, p. 35-40.

Description of a recently developed loran/inertial-aided weapon delivery system for fighter bombers. The system described uses a dedicated computer to combine the functions of navigation, guidance, and weapon delivery into a fully integrated system. The optimal mixing of loran and inertial parameters eliminates the need for recalibration and provides accurate position data at all times. Continuous computation of weapon impact range allows evasive maneuvers up to and through the moment of weapon release. The result is a highly accurate, all-weather navigation, guidance, and weapon delivery system requiring fewer pilot operations than ever before.

A.B.K.

A72-33299 Thermomechanical processing of nickel-base alloys. B. H. Kear, J. M. Oblak, and W. A. Owczarski (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *Journal of Metals*, vol. 24, June 1972, p. 25-32, 17 refs.

Potentially, the most promising application for the thermomechanical treatment (TMT) of nickel-base alloys is in the fabrication of components such as disks or shafts in aircraft gas-turbine engines. The maximum service temperature for such components does not exceed that where creep becomes a serious problem. Impressive progress has been made in the TMT processing of gamma prime precipitation hardened nickel-base alloys. The most striking advances in the state of the art have been made in the hot working area, where the conditions have been specified for obtaining superplastic-type behavior in several alloys by conventional forging, and for its utilization in the fabrication of fairly complex, massive shapes.

G.R.

A72-33306 Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. Conference sponsored by the Society of Automotive Engineers, American Institute of Aeronautics and Astronautics, and American Society of Mechanical Engineers. New York, Society of Automotive Engineers, Inc., 1972. 79 p. Members, \$12.75; nonmembers, \$15.75.

Economic and technological aspects of modern air transportation are discussed, covering airport-community relations, airport neighborhood reactions, area survey, airport construction economics, and air service demand forecasting. The topics also include the impact of O'Hare International Airport on Chicago, short-haul transportation issues, air transport propulsion systems, and the contribution of advanced aircraft engines to air transportation progress.

V.Z.

A72-33307 Construction economics and community impact. E. E. Dean. In: *Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings*. New York, Society of Automotive Engineers, Inc., 1972, p. 1-9.

A discussion of construction economics and community impacts of the new Dallas/Fort Worth Airport is presented. Planning and design criteria and a description of construction of the airport development are presented and serve as a background for the information pertaining to economics and related community impacts. To evaluate the economic effect of construction, two plots are presented and analyzed. The first plot pertains to the commitments and cash flow of construction funds as a function of time. The second plot pertains to the number of construction personnel on the

airport site as a function of time. Personnel levels and the construction costs are used as a basis for analyzing the impact on the economy of communities served by the airport. It is concluded that the construction of new, large scale airports has major impacts on the economy and life style of communities in the vicinity of the airport. (Author)

A72-33308 **The airport environment - Economic impact on the community.** G. Howard (Port of New York Authority, New York, N.Y.). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 10-16. 8 refs.

Economic studies which have attempted to identify and quantify the benefit of an airport to the regional economy are surveyed. Such studies have not, for the most part, attempted to evaluate the economic dependency of industry on air transportation. The benefits of air transportation cannot be adequately assessed simply by the multiplier effect or input-output analysis. Environmental studies such as those done by the Commission on the Third London Airport and by the National Academy of Sciences on the extension of Kennedy Airport into Jamaica Bay have been most comprehensive in their analysis of environmental costs. The decision to build a new airport or expand an existing one is an increasingly difficult one, involving a complex mixture of institutional, environmental and economic issues. This makes it all the more imperative for the evaluators of these major public projects to give full weight to all the identifiable benefits and costs so that planning decisions can be made rationally with full knowledge of the consequences.

(Author)

A72-33309 **Area survey of airport environs economic reactions - Present and future.** G. J. Bean (Hillsborough County Aviation Authority, Tampa, Fla.). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 17-24. 21 refs.

Past impact of the airport on the community can readily be measured through analysis of historic economic data which has been assembled in the individual community. Measurement of present economic impact involves the overlaying of airport growth data on that of the general community surrounding the airport. Measurement of future airport economic impact on its environs must deal in large part with the intangible qualities of surveys and forecasts relating to the community's continued development. The highest degree of direct economic support given to the community starts within the airport itself. The secondary level of economic impact covers those areas directly adjoining the airport, and finally, the impact can be measured in terms of the airport's interplay with the community, expressed as the entire trade which the airport serves. (Author)

A72-33310 * **Problems and issues for short-haul air transportation.** J. F. Vittek, Jr. (MIT, Cambridge, Mass.). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 32-36. NASA-sponsored research.

The problems of developing an efficient short-haul air system are not primarily technical, but economic and political. The key issues are whether the community will accept new and expanded air facilities, what standards of service the passengers will demand and how the system will evolve. The solutions recommended are national in scope and require the federal government to take a leading role.

(Author)

A72-33311 **Forecasting air service demand.** G. W. James (Air Transport Association of America, Washington, D.C.). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 37-40.

In 1967 the airline industry embarked on a new forecasting project (an Airport Demand Forecast Study) to determine future traffic demands at individual airports as well as future nationwide air traffic. The study, involving many complex problems, has recently been completed. It will be used for airport planning purposes at major hubs across the country. The study forecasts demand far enough into the future to enable needed airport developments to be accomplished in time. (Author)

A72-33312 **The airport - A center of economic gravity.** J. A. Foster (Houston, Dept. of Aviation, Houston, Tex.). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 41-48. 12 refs.

The airport as an instrumentality of air transport services performs a function of substantial economic importance to the community and country it serves. It provides the facility that gives business and industrial communities access to a national and international air transport network that links cities and nations together. The economic impact of a major airport, both on neighboring real estate values and on the economy of the communities it serves, is quite substantial. An active commercial airport truly becomes a center of economic gravity within its market area.

(Author)

A72-33313 **The development of propulsion systems for air transport.** H. Pearson (Rolls-Royce, Ltd., Derby, England). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 49-61.

The paper briefly reviews the evolution of modern aero engines and analyses the forces which motivate continued technical development, especially the interaction with growth in traffic and aircraft size. The contribution of improved propulsion systems to the economics and regularity of air transport are examined with particular reference to developments during the past decade. There is some discussion of the environmental factors (particularly noise) raised by civil aviation, the progress already made to deal with them, and the possibilities for the future. The overall benefits of power-plant technical development particularly as they affect the general and travelling public are summarised.

(Author)

A72-33314 **How will new engines contribute to better air transportation.** R. C. Mulready and R. L. Staubach (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 62-67.

Engine technology has played a major role in establishing today's modern commercial transport aircraft as a vital part of the world transportation system. This paper discusses the significant advancements that have been made in air transportation and the contribution the engine has made to these advancements. Potential future improvements that could benefit the customer, community and operator are examined and new transport aircraft and engine possibilities indicated. The concern over the social and ecological compatibility of air transportation with the community will be a significant factor in future transport aircraft and engine design requirements. The impact of these demands on new engines and advanced technology requirements will be discussed. (Author)

A72-33315 **Aircraft engines - A vanguard of air transportation progress.** E. E. Hood, Jr. (General Electric Co., Commercial Engine Div., Cincinnati, Ohio). In: Air Transportation Conference, Washington, D.C., May 31-June 2, 1972, Proceedings. New York, Society of Automotive Engineers, Inc., 1972, p. 68-76.

The impact of the gas turbine on safety, reliability, and airline profitability; impact of the jet aircraft on international trade and development; new aircraft engines beget new and more productive airplanes; new technology has enhanced air transportation progress; and air transportation progress is benefitting the airlines; national interests, and all in our society, including the neighbors of our airports. (Author)

A72-33326 Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 285 p.

General topics of airport planning and management are covered in papers dealing with design of terminal areas, acquisition of airport facilities, choice of suitable aircraft to satisfy realistic operational requirements, special problems in underdeveloped countries, the role of STOL operations, financing, and international cooperation in civil aviation. Factors affecting the design of boarding areas, surface transit links, cargo handling systems, and safety devices are identified along with various planning and forecasting methods employed for future needs. Manpower training is discussed, and international assistance programs conducted by ICAO are described.

T.M.

A72-33327 # The elements of planning necessary for the development of a major civil airport. J. A. Foster. In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 24 p.; Discussion. 1 p. 49 refs.

Discussion of essential planning data required for the preparation of a comprehensive and graphic master plan of development for a major civil airport. Information gathering and processing methods are described for conducting forecasts of aviation demand, forecasts of aircraft movements, estimates of airport earning capability vs costs, forecasts of gross revenues and expenses, and evaluations of airport pricing policies. Experience gained with the planning of the Houston Intercontinental Airport is reviewed to illustrate practical countermeasures for specific development problems.

T.M.

A72-33328 # Various master plan solutions, concept for the various areas, 'STOLports.' J. Bachelez (Paris Airport Authority, Paris, France). In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 33 p.; Discussion. 3 p.

The preparation of a master plan of development for a major civil airport is examined in terms of (1) factors governing the choice of a suitable site and (2) objectives which should be met by the location, the dimensions, and the arrangement of the various installation areas covered in the master plan. Attention is given to traffic forecasts, number and orientations of runways, assessment of noise disturbances, airspace capacity, access systems, freight installations, maintenance facilities, navigation aids, control towers, technical and administrative buildings, and STOL ports.

T.M.

A72-33329 # Design factors - Passenger and cargo terminals and associated handling areas. E. B. Tutty (International Air Transport Association, Montreal, Canada). In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 15 p.; Discussion. 3 p.

The design and layout planning of a passenger terminal complex in a major civil airport are examined in terms of systems and flow routes intended to facilitate and shorten the beginning or the end of a journey by air. Requirements and guidelines are given for the

design of the interface with surface transit systems, check-in facilities, government control areas, information centers, baggage handling systems, passenger loading bridges, gate lounges, and electronic equipment. Aircraft parking aprons and required aircraft maneuvers are considered together with cargo handling facilities. T.M.

A72-33330 # FAA airport certification programme. J. S. Jamison (FAA, Washington, D.C.). In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 9 p.; Discussion. 3 p.

Description of the policy followed by the FAA in issuing airport operating certificates and in establishing minimum airport safety standards. Airport certification is shown to be conditional on the presentation of a satisfactory airport operations manual, a program of self-maintained inspection, a plan to be followed in specific emergency situations, proof of fire-fighting and rescue equipment, proper handling and storage of hazardous materials, orderly operation of ground vehicles, marking and lighting of runways, protection of navigation aids, protection of the public, and other factors. T.M.

A72-33331 # The development of the STOL concept and its future applications. E. H. Childs (British Airports Authority, London, England). In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 9 p.; Discussion. 2 p.

Efficient utilization of STOL aircraft capabilities for civil transport applications is discussed from the viewpoints of optimum aircraft design concepts, noise reduction measures, and terminal facility requirements. Potential uses of STOL aircraft in supplementing existing airports, providing service to smaller cities, and distributing air traffic throughout large urban areas are used to define optimum specifications for terminal locations, runway length, surface transit connections, and scheduling operations. T.M.

A72-33332 # Factors affecting growth of civil aviation in developing countries. S. Medhane (Ethiopian Airlines, S.C., Addis Ababa, Ethiopia). In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 11 p.; Discussion. 3 p.

Economic growth and future welfare of underdeveloped nations are shown to be strongly dependent on the establishment of efficient civil aviation, and special problems faced by airlines in these countries are outlined. Factors governing the evolution of airlines are identified with a realistic assessment of the role to be played, proper allocation of funds by governments, credibility in the international money markets, sufficient skilled manpower, suitable equipment, realistic fare structures, expansion of tourist travel, and interline cooperation. T.M.

A72-33333 # Factors in the selection of aircraft equipment. R. P. Norton (Boeing Co., Renton, Wash.). In: Civil Aviation Safety Centre, Annual Technical Conference, 6th, Beirut, Lebanon, November 30-December 3, 1971, Final Report. Beirut, Civil Aviation Safety Centre, 1971. 13 p.; Discussion. 3 p.

The selection of aircraft for use by commercial airlines is discussed in terms of proper evaluation of technical data and information offered by the manufacturer to a prospective customer. Attention is drawn to the need for distinguishing among operational objectives of profit, national development, promotion of tourism, or maintenance of international balance of payments. The choice among large, small, or medium size aircraft of short, intermediate, or long range capability is shown to be affected by economics, traffic forecasts, runway quality, maintenance and operating costs,

reliability, and cargo handling options. Route analysis and fleet planning are discussed, along with aspects of mutual airline support.

T.M.

A72-33373 # Assembly of aircraft engines /2nd revised and enlarged edition/ (Sborka aviatsonnykh dvigatelei /2nd revised and enlarged edition/). V. N. Belikov and A. N. Nikitin. Moscow, Izdatel'stvo Mashinostroenie, 1971. 236 p. 27 refs. In Russian.

Aircraft engine assembly operations are described in terms of process schedules, definition of assembly phases, organization of work areas, factors affecting precision, types of elements (joints and couplings) involved, and quality control measures. Static and dynamic balancing of machine elements is discussed, together with concepts of total and partial interchangeability of replacement elements. Bearings, press fittings, rivet and bolt joints, welded joints, and adhesive bonding are treated, along with special procedures to be followed in the assembly of specific parts in turbine engines and spacecraft rocket engines.

T.M.

A72-33374 The effect of regulation on the cost performance and growth strategies of the local service airlines. G. Eads. *Journal of Air Law and Commerce*, vol. 38, Winter 1972, p. 1-34. 50 refs.

It is shown that the performance of local service carriers has fallen short of the goals set by the Civil Aeronautics Board when this carrier group was established in the 1940s. The failure is attributed mostly to faulty government regulation. It is shown that the quality and quantity of airline service provided to the smaller communities has deteriorated over the last ten years, while the cost to the federal government of providing this service has increased. Of the options which the government now has, preference is given to the option of permitting the CAB to try a new scheme of subsidization involving competitive bidding for the right to provide stated quantities of service. Superior service at substantially lower cost is expected from this step, but pitfalls which may prevent such a scheme from working in practice are pointed out.

V.P.

A72-33375 The Brazilian experiment in the creation of an aircraft industry. B. M. Carl. (Southern Methodist University, Dallas, Tex.). *Journal of Air Law and Commerce*, vol. 38, Winter 1972, p. 35-51. 76 refs.

The methods employed in Brazil to finance the creation of a domestic aviation industry are examined. In structuring its development laws, Brazil adopted a unique approach of 'mixed-economy' corporations. By this blend of public and private ownership, coupled with foreign and domestic technology and a system of tax incentives designed to assist in obtaining adequate capitalization, Brazil hopes to overcome the economical and technical obstacles to the achievement of an industry competitive in the world market. If successful, the Brazilian venture may serve as a model for other countries in their economic development.

V.P.

A72-33401 The wave formation and sonic boom due to a delta wing. K. Oswatitsch and Y. C. Sun (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für theoretische Gasdynamik, Aachen, West Germany). *Aeronautical Quarterly*, vol. 23, May 1972, p. 87-108. 17 refs.

Investigation of the influence of near-field flow on the far-field wave formation for an incident flat delta wing with supersonic leading edges, employing the analytical method of characteristics and a limiting procedure suitable for dealing with the trailing-edge expansion. Though confined in its scope to the front shock in the vertical plane of symmetry of the wing and to a homogeneous atmosphere without density and temperature gradients, the present analysis reveals features of flow which are interesting from the

standpoint of the general theory of three-dimensional supersonic flow. It is found that the front shock due to a delta wing will as a rule be canceled at a finite distance from the wing by the plane-wave expansion emanating from the trailing edge. The overexpansion must then give rise to a rear shock separate from the front one. Thus, at least in the plane of symmetry, a sharp-front wave signature cannot, in general, be expected from the wing at a distance beyond the terminating point of the front shock. The boom signature will then be qualitatively different from that of a body of revolution. (Author)

A72-33403 The flow in S-shaped ducts. P. Bansod (City University, London, England) and P. Bradshaw (Imperial College of Science and Technology, London, England). *Aeronautical Quarterly*, vol. 23, May 1972, p. 131-140. 16 refs.

Measurements are presented of total pressure, static pressure, surface shear stress and yaw angle in the flow through several S-shaped ducts, each with a thin turbulent boundary layer at entry. The results show that the region of low total pressure in the exit plane, found by previous workers, is due to expulsion of boundary-layer fluid by a pair of contra-rotating vortices in the boundary layer. The generation of these vortices is explained: similarly-produced vortices, with similar effects, occur in some types of wind-tunnel contraction and possibly in other three-dimensional flows. (Author)

A72-33404 The impact of an axisymmetric jet onto a normal ground. L. J. S. Bradbury (Surrey University, Guildford, Surrey, England). *Aeronautical Quarterly*, vol. 23, May 1972, p. 141-147. 5 refs.

The impact of an axisymmetric jet onto a ground board is a flow of some interest in VTOL aircraft aerodynamics. This paper presents a simple argument for correlating data obtained in the impact region from different nozzle configurations and for different nozzle heights above ground. The argument is applied, in particular, to the static pressure on the ground board and to the peak dynamic head in the flow over the ground board. (Author)

A72-33409 # Calculation of the natural frequencies and modes of vibration of a free glider (Obliczanie czestosci i postaci drgan wlasnych swobodnego szybowca). M. Nowak. *Archiwum Budowy Maszyn*, vol. 19, no. 2, 1972, p. 283-299. 12 refs. In Polish.

The proposed method of calculating the natural frequencies and modes of vibration of a free material system differs from other widely used methods in that it reduces the calculation to an eigenvalue problem of a symmetrical matrix. Example calculations of the vibrations of a free glider are used to demonstrate useful procedures for replacing a complex three-dimensional structure by an approximate model of a system with a finite number of degrees of freedom.

T.M.

A72-33423 Improvement of the flight characteristics for the landing approach by the coupling of spoiler and elevator deflection (Verbesserung der Flugeigenschaften im Landeanflug durch Kopplung von Spoiler- und Höhenruderausschlag). G. Sachs (Darmstadt, Technische Hochschule, Darmstadt, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 20, May 1972, p. 194-204. 11 refs. In German.

The effects of the coupling of spoiler and elevator deflection on the behavior of airplanes (pitch, flight-path angle, speed) are presented whereby an intended delay of the spoiler displacement is included in the investigations. The coupling yields a considerable increase of the quasi-steady load factor, and flight path response characteristics can be improved. This is especially important for the landing approach. Corresponding to the direct effect on lift caused by the spoiler deflection, the method simultaneously has the character of a direct lift control. Furthermore, it is possible to eliminate the problem of speed instability which denotes the control

difficulties at speeds below the speed of minimum drag. Consequently, restrictions resulting from the flight path stability requirement can be removed. Contrary to flaps which also can be used for the coupling with the elevator, in the case of spoilers, the drag changes are combined with the lift changes in such a manner that they essentially contribute to the solution of the problem of speed instability. (Author)

A72-33500 The fog dispersal problem in the United Kingdom. G. H. Forster. London, Civil Aviation Authority, 1972. 18 p.

The current state of fog dispersal efforts in the United Kingdom is discussed, covering their history, fog dispersal progress since World War II, fog conditions at London airports, vast expenditures in 1971 in the U.S., and the incidence of fog vs traffic. Cost analysis projection is given for a complementary fog dispersal system, involving chemical seeding with laser and lidar remote sensing instruments as substitutes for a less effective radar technique. V.Z.

A72-33501 Selecting a basic flight procedure trainer. R. P. Terry (Oxford Air Training School, Oxford, England). *Shell Aviation News*, no. 406, 1972, p. 8-11.

The criteria employed in the selection of the flight trainer are discussed together with the available models taken into consideration. As a result of the investigation it was decided to evaluate the Model 101-G of Frasca Aviation. The trainer incorporates a model aircraft positioned in the student's line of sight. Various adjustments were made to adapt the trainer to the particular requirements involved. The various aspects in the employment of the Model 101-G as a teaching tool are examined. G.R.

A72-33521 # New generation distance measuring equipments. D. Graziani (Face Standard, Milan, Italy). *Electrical Communication*, vol. 47, no. 2, 1972, p. 113-116. 7 refs.

The success of new ground-based distance measuring equipment (DME) depends mainly on the extensive use of solid state devices, new logic circuits, and increased reliability. A DME receiver is described that uses a strong, instantaneous, automatic gain control on the IF amplifier. This control is capable of reducing the gain by at least 60 dB, thus allowing full sensitivity of the ground receiver to be restored a few seconds after reception of a strong signal. The ground beacon uses a full band power amplifier that is a single, compact module capable of delivering a peak power of more than 2 kW. With a view toward improving distance accuracy of next generation DME that are used for landing, several improvements are suggested. These include full solid state equipment, new shape of the transmitted pulses, automatic control, and first pulse detection. D.F.L.

A72-33525 The Boeing 747 is not immune against clear air turbulence. E. R. Reiter and W. R. Green (Colorado State University, Fort Collins, Colo.). *Archiv für Meteorologie, Geophysik und Bioklimatologie, Serie A - Meteorologie und Geophysik*, vol. 21, no. 1, 1972, p. 27-34.

Upper-air analyses are presented for a case of strong turbulence, presumably CAT, that befell a Boeing 747 on November 4, 1970, near Nantucket Island. Although there were thunderstorms in the vicinity, the main cause for the incident appeared to have been shear-generated turbulence typical of CAT. It is pointed out that it is due to the airworthiness of the B-747 and to the alertness of its crew that a major disaster could be averted. G.R.

A72-33539 Green light for Autoland. H. Field. *Flight International*, vol. 101, June 8, 1972, p. 838-842.

The ultimate goal of Autoland development is clearance for its

operations in Cat 3b weather conditions. No further development of the system is required in order to reach this goal. However, comprehensive data demonstrating system reliability are to be acquired. Every Trident 3B carries as part of the ship's library a 64-channel cassette recorder, and every Autoland is automatically analyzed. An in-service program of 5,000 recorded approaches has been called for before the approval will be granted to operate in Cat 3b. G.R.

A72-33600 Probabilistic assessment of aircraft hazard for nuclear power plants. C. V. Chelapati (California State College, Long Beach; Holmes and Narver, Inc., Los Angeles, Calif.), R. P. Kennedy (Holmes and Narver, Inc., Los Angeles, Calif.), and I. B. Wall (General Electric Co., Atomic Power Equipment Dept., San Jose, Calif.). (*International Conference on Structural Mechanics in Reactor Technology*, 1st, Berlin, West Germany, Sept. 20-24, 1971.) *Nuclear Engineering and Design*, vol. 19, no. 2, 1972, p. 333-364. 41 refs.

An analysis is made of aircraft accidents to establish the probability of an aircraft striking a nuclear power plant and the frequency distribution for aircraft. Various empirical perforation formulas and the development of a new empirical formula for the determination of perforation thickness are discussed. Using the Monte Carlo method and yield line theory, respectively, the probability of perforation and the probability of collapse mode of damage is determined. Finally, the cracking mode of damage is discussed using elastic theory and finite-element idealization. O.H.

A72-33609 An instrument for the automatic control of speed in low-speed wind tunnels. T. Robertson and J. G. Burns (Edinburgh, University, Edinburgh, Scotland). *Journal of Physics, Part E - Scientific Instruments*, vol. 5, June 1972, p. 598-600. Research supported by the Science Research Council.

The frequency of eddy shedding by a circular cylinder at constant Strouhal number is shown to be suitable for the measurement of flow velocity in wind tunnels. A wind speed monitor and regulator designed on this principle for an on-line experiment has operated successfully at speeds ranging from 4 to 20 m/sec, and the system is adaptable also to other speed ranges. M.V.E.

A72-33627 Aircraft landing measurement system. N. P. Robinson (Marconi-Elliott Avionic Systems, Ltd., Rochester, Kent, England). In: *International Aerospace Instrumentation Symposium*, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 1.1-1.8.

Description of an aircraft landing measurement system (A.L.M.S.) providing a computer analysis for air traffic landing at a major civil airport. The system uses groups of optical, seismic and IR sensors for landing aircraft performance measurement, and a central processor unit for data recording on punched paper tapes. A preliminary assessment of the system is given. V.Z.

A72-33628 An integrated system of airborne and ground-based instrumentation for flying qualities research with the X-22A airplane. J. L. Beilman (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). In: *International Aerospace Instrumentation Symposium*, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 2.1-2.12.

This paper considers the use of an integrated system of airborne ground-based instrumentation used for flying qualities research with the X-22A, a VSTOL airplane specifically designed to be a variable stability airplane. It discusses several unique features of the X-22A airplane as well as the telemetry system, the mobile instrumentation van and its equipment, landing aids employed, experience to date, and future plans. (Author)

A72-33629 DAMIEN III: A new conception of recording systems for flight tests - An application of the ARINC 573 recording systems for airliners. C. Jouvenot (Société de Fabrication d'Instruments de Mesure, Massy, Essonne, France). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 4.1-4.8.

The applicability of the DAMIEN III digital magnetic tape recording system, an outgrowth of the ARINC 573 recording system, in airliner flight test data acquisition is discussed. The DAMIEN III includes a data acquisition unit with a series of signal conditioners, complementary conditioning plates, a control and sampling programming panel, a synchronization subunit, and an analog or digital magnetic tape recorder. V.Z.

A72-33635 The civil application of infra-red scanning techniques using an airborne external instrumentation pod. G. L. Lamers (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 16.1-16.10.

At the National Aerospace Laboratory (NLR), instrumentation pods are used for installing test equipment on aircraft. The reasons for using such an installation are discussed. Under contract with a governmental working ground, NLR conducts flight trials with a pod containing an infrared scanner and the associated test equipment. A description of the aircraft installation is given, and some operational experience is discussed. Some results of infrared surveys of water and land surfaces for different purposes are presented. (Author)

A72-33637 Static pressure error - An empirical study. A. W. Brant (Negretti and Zambra /Aviation/, Ltd., Croydon, Surrey, England). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 19.1-19.3.

The paper outlines the method adopted to establish a simple relationship between static pressure error and measurable flight parameters. Linear relationships were established in respect of many, including supersonic aircraft, and the accuracy of matching to particular characteristics was frequently within 50 ft, the standard deviations being typically 3% of the uncorrected static pressure error. (Author)

A72-33639 Measurements in nonsteady flight - Instrumentation and analysis. H. L. Jonkers, J. A. Mulder, and K. van Woerkom (Delft, Technische Hogeschool, Delft, Netherlands). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 21.1-21.10. 8 refs.

The subject of this paper is a method to derive performance, stability, and control characteristics from measurements in nonsteady flight. This method has been developed at the Delft University of Technology during the past decade. A description of a new flight test instrumentation system for measurements in nonsteady flight is presented. Some aspects of the analysis of the measurements are

A72-33640 The influence of instrumentation system accuracy on the evaluated aerodynamic derivatives of an aircraft from flight data. V. Klein (Cranfield Institute of Technology, Cranfield, Beds., England). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 22.1-22.11. 7 refs.

The paper considers the relation between the accuracy of an instrumentation system and the accuracy of the evaluated aerodynamic derivatives of an aircraft from flight data using simulated and measured time histories. On the basis of the results obtained and other available information, the basic performance characteristics of a system for the accurate measurement of input and transient response data are proposed. (Author)

A72-33641 Correlation techniques applied to the dynamic testing of aircraft autoland systems. J. D. Lamb, A. R. Pankhurst, and D. R. Towill (University of Wales Institute of Science and Technology, Cardiff, Wales). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 23.1-23.7. 13 refs. Research sponsored by the Science Research Council and Ministry of Defence.

The paper describes experiments carried out on a jet aircraft possessing an autoland facility. These experiments are carried out on the ground with the autoland loop closed through simulated engine and aerodynamic characteristics. Cross-correlation functions associated with small height perturbations are obtained by injecting pseudo-random sequences into the system. Significant changes in the cross-correlation function are observed as the system dynamics change, thus offering the possibility of using this approach as a rapid checkout procedure. (Author)

A72-33642 New digital recording methods for flight data acquisition. J. M. King (Royal Aircraft Establishment, Farnborough, Hants., England). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 24.1-24.15. 54 refs.

Discussion of the qualities of various techniques as alternatives to magnetic tape recording in airborne data acquisition systems. Special attention is given to such applications of laser beam holographic recorders. The magnetic bubble store and the laser beam holographic recorder are found to show the greatest promise for airborne digital data acquisition systems. V.Z.

A72-33644 The philosophy and implementation of a serial PCM system. J. M. Aucken and H. N. Welby (Hawker Siddeley Aviation, Ltd., Kingston-upon-Thames, Surrey, England). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 26.1-26.10.

Discussion of the quality of a new flight test data acquisition and reduction system using a serial pulse code modulation, as a possibly more advantageous one than the established Harrier system. Points requiring proof to demonstrate the viability of the new system are specified. The performance characteristics and the applicability ranges of the Harrier system and the new system are compared. V.Z.

A72-33645 The modular design of digital data acquisition systems for flight test purposes. M. Catton (Plessey Co., Ltd., Havant, Hants., England). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 27.1-27.14.

Description of an airborne data acquisition system providing digital readings (to a recorder or telemetry link) from analog signals supplied by a large number of various monitoring transducers. The wide range of requirements dictated by the parameter sensors is satisfied by using a set of circuit modules permitting systems of varying functions and complexity to be assembled from standard units. System considerations that have determined the range of

modules chosen for initial development are described together with the operation and performance of specific modules that have a major influence on the characteristics of the complete system. T.M.

A72-33650 **Hydrofluidic circuit helps handle helicopter.** R. A. Evans (Honeywell, Inc., Government and Aeronautical Products Div., Minneapolis, Minn.) and G. W. Fosdick (U.S. Army, Aviation Material Laboratories, Fort Eustis, Va.). *Hydraulics and Pneumatics*, vol. 25, June 1972, p. 91-93.

A hydrofluidic three-axis stability augmentation system is described which was developed to improve vehicle damping and handling qualities of the UH-1B, without stabilizer bar, during high-speed gunfiring missions. The three-axis stabilization system has three individual pitch-, roll-, and yaw-axis controllers, and three series servoactuators. Detailed design specifications for the stabilization system were written from the six-degree-of-freedom linear perturbation equations of motion which represent mathematically the UH-1B helicopter and from computer simulation diagrams of the stabilization system. V.P.

A72-33679 **Natural vibrations of thin-walled rods and longitudinally stiffened plates and cylindrical shells with allowance for local deformations of the cross section (Eigenschwingungen von dünnwandigen Stäben, Längsversteiften Platten und Zylinderschalen unter besonderer Berücksichtigung örtlicher Verformungen des Querschnitts).** J. Sternberg (Berlin, Technische Universität, Berlin, West Germany). In: Technische Universität Berlin, Institut für Luftfahrzeugbau, Yearbook 1970. Düsseldorf, VDI-Verlag GmbH, 1972, p. 237/1-359. 55 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

The eigenvalues of aircraft and rocket structural elements are calculated with the aid of transfer matrices. The structural elements are treated as strips of constant thickness. The vectors are then related by the matrix product of the individual field matrices. Local vibrations are calculated on the assumption of rectilinear nodal lines between the strips (or that the nodal lines arch only in the circumferential direction, in the case of a cylindrical shell). V.P.

A72-33695 # **Nonlinear vortex interactions on wing-canard configurations.** D. Finkleman (USAF, Frank J. Seiler Research Laboratory, Colorado Springs, Colo.). *Journal of Aircraft*, vol. 9, June 1972, p. 399-406. 28 refs.

Sacks' method of simulating vortex sheets with distributions of discrete vortices has been applied to the study of the interaction of a slender wing with a nearby canard surface. The canard is detrimental to both lift and static longitudinal stability. The extent of canard vortex sheet rollup is very important in the interaction. Downward canard deflection may lead to increased lift. For small vertical separations between the surfaces, the forward portion of a pointed wing preceded by a canard is ineffective in producing lift. Vortices of negative sense may be shed when a canard is very close to the wing, and the forward portion of a slender wing in close proximity to a canard surface is ineffective in producing lift. G.R.

A72-33698 # **Scale-model studies of blast-deflection fences for high thrust engines.** J. J. Bertin and J. C. Westkaemper (Texas, University, Austin, Tex.). *Journal of Aircraft*, vol. 9, June 1972, p. 445, 446. Research supported by the Dallas/Fort Worth Regional Airport Authority.

An 0.02 scale model was constructed to represent a twin-engine aircraft, the proposed fence geometries, and the adjacent service roads requiring traffic protection. Data were obtained to define the flowfield immediately upstream of the fence and downstream to the roads. In addition to a single, long primary fence, flowfield data were obtained for double fences in which a smaller, auxiliary fence was

located upstream of the primary fence to provide a sheltered area for ground service equipment. The results of the experimental investigation are discussed. G.R.

A72-33791 **A matrix displacement method for temperature-dependent elastoplastic wing assemblies and continua (Matrizenverschiebungsmethode für temperaturabhängig elastisch-plastische Tragwerke und Kontinua).** D. Radaj (Stuttgart, Universität, Stuttgart, West Germany). *Acta Mechanica*, vol. 14, no. 1, 1972, p. 71-78. 18 refs. In German.

Review of current analysis techniques for nonlinear elastoplastic wing assemblies made of materials whose properties are not affected by temperature variations. A modified version of the matrix displacement method is developed to treat the cases where the elastoplastic properties of the material are temperature-dependent. Exact analysis can be conducted at varying temperature by using the modified method. V.Z.

A72-33797 # **The upper atmospheric environment of the supersonic transport: A bibliography.** A. McLellan (Wisconsin, University, Madison, Wis.). Madison, Wis., University of Wisconsin, 1972. 205 p. \$5.00.

General references pertaining to the structure, composition, and the physical dynamics of the stratosphere are listed together with studies regarding the constituents that make up the composition of the ambient gases available to undergo chemical reactions with the pollutants, the temperature of the stratosphere, and heat flux variations. Other subjects considered include the winds and the transport properties of the stratosphere, the properties of the mesosphere, circulation, synoptic dynamics, and energetics of the stratosphere. G.R.

A72-33874 # **Flight dynamics (Dinamika poleta).** A. M. Mkhitarian, P. A. Mezhlumian, V. S. Maksimov, P. S. Lazniuk, V. Ia. Fridland, L. G. Totiashvili, and E. I. Sorokin. Moscow, Izdatel'stvo Mashinostroenie, 1971. 369 p. 28 refs. In Russian.

The textbook (representing a university course on flight dynamics) examines the characteristics of horizontal flight, and of the takeoff, climb, and landing phases. The stability and controllability of an aircraft and its behavior at supercritical angles of attack under unfavorable meteorological conditions are discussed. A chapter is devoted to helicopter flight dynamics. The equations of motion of an aircraft are written in a velocity and coupled system of coordinates, the first being used for solving trajectory problems, and the second in stability and controllability analysis. The stability analysis is based on linear equations of perturbed motion. By using a unified system of coordinates, it proves possible to treat stability and controllability on the basis of the general theory of the stability of motion of a mechanical system. V.P.

A72-33946 # **Hail in the vicinity of organized updrafts.** A. H. Auer, Jr. and J. D. Marwitz (Wyoming, University, Laramie, Wyo.). *Journal of Applied Meteorology*, vol. 11, June 1972, p. 748-752. 13 refs. Research supported by the Research Council of Alberta; NSF Grants No. GA-1527; No. GA-19105.

Several encounters with hail and graupel (often inadvertent) have occurred while flying an aircraft through the organized updrafts at the base of thunderstorms in the High Plains area. These encounters normally occurred while entering or exiting the organized updrafts and while flying in the vicinity of the strong horizontal reflectivity gradients which commonly border organized updrafts. On several occasions mobile ground crews were beneath the organized updrafts and confirmed the observations from the aircraft. These crews also noted the sequence of precipitation events in this region. The hail which falls in this particular region has the following

characteristics: it has a narrow size range, it is large hail (often the largest which falls from the storm), it is commonly not accompanied by rain, and it has a small range of concentrations for a given diameter. The precipitation sequence at the ground over which an organized updraft passes is large hail followed by smaller hail and rain. (Author)

A72-33960 # Errors of an inertial navigation system using a gyrohorizoncompass (K voprosu o pogreshnostiakh inertsial'noi navigatsionnoi sistemy, postroennoi na osnove girogorizontkompasa). V. A. Karakashev and S. Ia. Rozhetskii (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad, USSR). *Priborostroenie*, vol. 15, no. 4, 1972, p. 76-81. In Russian.

Analysis of the course errors, coordinate errors and speed errors of an inertial navigation system using a gyrocompass and a gyrohorizoncompass. Expressions are derived to determine the dependence of these errors on the instrumental errors of the gyrosystems. Details are given on specific types of errors. V.Z.

A72-34060 * # Analytic prediction of dynamic stall characteristics. L. E. Ericsson and J. P. Reding (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-682*. 18 p. 48 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS1-9987.

A new approach is presented for solving the problem of predicting dynamic stall characteristics. In this approach, the unsteady aerodynamic characteristics are related theoretically to static aerodynamic characteristics which are readily available for a great number of airfoil shapes. Using these static experimental data as an input, the developed analytical method predicts dynamic stall characteristics that are in good agreement with available experimental data. The analysis is also extended to include frequency and amplitude modulation effects. O.H.

A72-34061 # A time-dependent solution of mixed flow through convergent nozzles. E. F. Brown and H. M. Ozcan (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-680*. 9 p. 10 refs. Members, \$1.50; nonmembers, \$2.00. NSF Grant No. GK-5223.

An analytical solution is presented which enables the performance of convergent nozzles operating at supercritical pressure ratios to be predicted. The results of a typical calculation are compared with experimental data and with the predictions of existing analyses. The method employs the nonconservative form of the governing equations and a new treatment of the jet-boundary points which makes use of the time-dependent method of characteristics. Calculations reveal good convergence properties, are in good agreement with experimental data, and possess an accuracy superior to that which can be obtained with existing methods. The computational speed of this method is four times that of only other time-dependent solution of this problem. (Author)

A72-34063 * # Numerical calculation of transonic flow about swept wings. W. F. Ballhaus and F. R. Bailey (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-677*. 11 p. 13 refs. Members, \$1.50; nonmembers, \$2.00.

Description of a mixed elliptic-hyperbolic relaxation algorithm which calculates solutions to the three-dimensional, nonlinear transonic small disturbance potential equation for flows about thin swept lifting wings with free-stream Mach number less than 1. The

algorithm is designed to treat supercritical flows, including cases with embedded shock waves. Nonrectangular planform shapes, including sweep and taper, are treated by a coordinate transformation which maps the wing planform into a rectangle. Computed results at angles of attack of 0 and 2 deg for a AR = 4, constant chord, 23.75 deg sweptback planform model with a Lockheed C141 airfoil section are compared with data obtained experimentally for both subcritical and supercritical flows. Subcritical results are also compared with those obtained by a subsonic 'panel' method. (Author)

A72-34070 * # Prediction of internal and external noise fields for blowdown wind tunnels. R. N. Hosier and W. H. Mayes (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-668*. 6 p. 11 refs. Members, \$1.50; nonmembers, \$2.00.

Empirical methods have been developed to estimate the test section noise levels and the outside noise radiation patterns of blowdown wind tunnels. Included are considerations of noise generation by control valves, burners, turbulent boundary layers, and exhaust jets as appropriate. Sample test section and radiation field noise estimates are presented. The external estimates are noted to be in good agreement with the limited amount of available measurements. (Author)

A72-34072 * # Maximum noise abatement trajectories. S. Zeldin and J. Speyer (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-665*. 16 p. 10 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS2-6437. DSR Project 55-45900.

Minimum noise annoyance trajectories for developing STOL operation procedures are obtained by modulating five control variables in two dimensions. The performance index is formulated such that it explicitly assigns the same relative importance to thrust as it does to distances between discrete listeners and the aircraft. However, using a steepest descent optimization program, results indicate that it is preferable to keep the thrusters at their maximum value to minimize the integrated annoyance rather than to reduce thrust which would lower the instantaneous annoyance. Thrust decreases below its bound only when the instantaneous noise at a listener is limited. (Author)

A72-34076 # Assessment of climatic changes due to flights in the stratosphere. A. J. Grobecker (U.S. Department of Transportation, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-658*. 17 p. Members, \$1.50; nonmembers, \$2.00.

The Department of Transportation's Climatic Impact Assessment Program is described. The objective of this program is to assess, in the form of a report in 1974, the impact of climatic changes resulting from perturbation of the upper atmosphere by the propulsion effluents of a world high-altitude aircraft fleet as projected to 1990. The nature of the stratosphere is to be considered together with the propulsion effluents, the perturbations in the stratosphere and troposphere, the biological environmental effect of the tropospheric changes, and the economic aspects involved. G.R.

A72-34077 * # The NASA/GE quiet engine 'A.' M. J. Benzakein, S. B. Kazin (General Electric Co., Cincinnati, Ohio), and F. Montegani (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-657*. 9 p. 5 refs. Members, \$1.50; nonmembers, \$2.00. Contract no. NAS3-12430.

The National Aeronautics and Space Administration and the General Electric Company are jointly developing two low noise propulsion technology demonstrators (Engine 'A' and 'C' incorporating respectively a low tip speed and high tip speed fan) under the Experimental Quiet Engine Program. The acoustic and aerodynamic performance characteristics of Engine 'C' which is currently on test will be reported at a later date. The present paper describes the design, component development and engine evaluation of the 'A' demonstrator. The aerodynamic and acoustic performance obtained on the fan component are discussed. The demonstrator engine acoustic test program is outlined. The effect of inlet geometry and duct acoustic treatment are presented. The static acoustic data are extrapolated to flight and compared with the FAA noise regulations. (Author)

A72-34078 # Vortex noise of isolated airfoils. R. W. Paterson, P. G. Vogt, M. R. Fink, and C. L. Munch (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-656.* 10 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. DAHC04-69-C-0089.

Description of an experimental study of airfoil vortex shedding noise in a low-turbulence flow and in a Reynolds number range applicable to full-scale helicopter rotors. Measurements of far-field noise, airfoil surface pressure fluctuations, and correlation coefficients were obtained for NACA 0012 and NACA 0018 two-dimensional models and a finite-span NACA 0012 airfoil. Airfoil vortex shedding noise was found to be discrete rather than broadband, with the frequency predicted by a Strouhal number of approximately 0.2 referenced to twice the trailing-edge laminar boundary layer thickness. At Reynolds numbers and angles of attack for which this boundary layer was turbulent on both surfaces, vortex noise was undetectable above turbulent boundary layer noise. The effects of airfoil thickness change and finite airfoil span were found to be small, consistent with their influence on the pressure-surface laminar boundary layer. (Author)

A72-34079 # Effect of leading edge serrations on noise radiation from a model rotor. R. E. A. Arndt (Pennsylvania State University, University Park, Pa.) and R. T. Nagel. *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-655.* 10 p. 11 refs. Members, \$1.50; nonmembers, \$2.00. Navy-supported research.

The possibility of using leading edge serrations for rotor noise reduction is examined experimentally. Consideration is given to both the acoustic and aerodynamic characteristics of rotors with and without leading edge devices. Measurement of total radiated power, directivity and near field sound pressure level all indicate that reduction in noise is possible with specific leading edge configurations and running conditions. Both vortex noise and rotational noise is attenuated. Hot wire and flow visualization studies indicate that the reduction in vortex noise is associated with changes in the vortex shedding characteristics. Reductions in rotational noise are correlated with thrust and torque data. (Author)

A72-34080 * # Ballistic range investigation of sonic-boom overpressures in water. G. N. Malcolm and P. F. Intrieri (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-654.* 12 p. 7 refs. Members, \$1.50; nonmembers, \$2.00.

An investigation of sonic-boom overpressures in water has been conducted by gun-launching small cone-cylinder models over water. Flights were conducted at Mach numbers of 2.7 and 5.7, in air,

corresponding to Mach numbers of 0.6 and 1.3, respectively, in water. Shadowgraph pictures and underwater pressure measurements indicate that for horizontal flights at Mach numbers below Mach 4.4 in air (i.e., subsonic relative to the speed of sound in water) the resulting underwater disturbance is an acoustic wave whose peak pressure attenuates rapidly with water depth. In contrast, at supersonic Mach numbers, relative to water, the incident shock wave at the surface is transmitted into the water as a propagating shock wave and the peak pressure associated with it does not attenuate with water depth. (Author)

A72-34081 # An analytical study of some possible sonic boom alleviation schemes. F. W. Lipfert (General Applied Science Laboratories, Inc., Westbury, N.Y.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-653.* 13 p. 25 refs. Members, \$1.50; nonmembers, \$2.00. U.S. Department of Transportation Contract No. FA70WA-2320.

The potential of modifying supersonic aircraft sonic boom signatures by means of altering the flow field in the vicinity of the aircraft has been investigated theoretically using a specific airplane and real atmospheric properties. Finite rise times, reduced overpressures, and reduced shock pressure rises were among the signature improvements investigated. Flow field alteration mechanisms considered included free combustion, boundary layer mass addition, force fields, and laser-generated heat fields. Weight penalties of the order of the baseline aircraft gross weight were found for all attempts to modify the complete baseline aircraft signature. If this additional weight were borne by the baseline aircraft, an additional overpressure would result which would, in many cases, negate the effect of the signature improvement. (Author)

A72-34082 # Studies on sonic boom at high Mach numbers. Y. S. Pan and M. O. Varner (Tennessee, University, Tullahoma, Tenn.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-652.* 12 p. 24 refs. Members, \$1.50; nonmembers, \$2.00.

Theoretical studies on sonic boom at high Mach numbers are presented. For a sharp-nosed slender axisymmetric body, the flow field is studied based on a shock-expansion method. To the first approximation, a quasi-linear approach to the rotational flow field behind the attached finite leading shock wave is presented. It is found that the cumulative effects of the rotational flow field modify the shock position and the pressure signature in the far field. For a blunt-nosed body at hypersonic speeds, the far-field flow patterns are obtained by using the hypersonic equivalence principle and the existing near-field cylindrical wave solution. Both methods of calculation are outlined. Examples are presented and limitations of the present studies are discussed. (Author)

A72-34084 * # Dispersion of SST trails in the stratosphere. T. J. Overcamp and J. A. Fay (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-650.* 7 p. 12 refs. Members, \$1.50; nonmembers, \$2.00. Grant No. NGL-22-009-378.

A simple theory for the dispersion of the exhaust of a supersonic transport cruising in the stratosphere is presented. This model shows that far downstream from the aircraft, buoyancy dominates the growth of the wake. This growth is limited by the stable stratification of the atmosphere. Data on the visible width of the wake from scaled experiments in a towing tank and from studies on the growth of contrails of subsonic aircraft verify the growth of the wake in an unstratified atmosphere is predicted by the model. This growth is faster than would be predicted for the wake of an axisymmetric body with no buoyancy. (Author)

A72-34087 * # Effects of rotating flows on combustion and jet noise. I. R. Schwartz (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-645.* 10 p. 23 refs. Members, \$1.50; nonmembers, \$2.00.

Experimental investigations of combustion in rotating (swirling) flow have shown that the mixing and combustion processes were accelerated, flame length and noise levels significantly decreased, and flame stability increased relative to that obtained without rotation. Unsteady burning accompanied by a pulsating flame, violent fluctuating jet, and intense noise present in straight flow burning were not present in rotating flow burning. Correlations between theory and experiment show good agreement. Such effects due to rotating flows could lead to suppressing jet noise, improving combustion, reducing pollution, and decreasing aircraft engine size. Quantitative analysis of the aero-acoustic relationship and noise source characteristics are needed. (Author)

A72-34088 # Turbulence and acoustic characteristics of screen perturbed jets. R. E. A. Arndt (Pennsylvania State University, University Park, Pa.), N. Tran, and G. Barefoot. *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-644.* 11 p. 20 refs. Members, \$1.50; nonmembers, \$2.00. Navy-supported research.

The placement of a screen across a jet flow results in a substantial reduction in noise. This paper describes an experimental investigation of the phenomenon, consisting of two parts: acoustic measurements with a 2-inch air jet in an anechoic chamber and velocity and pressure measurements in the mixing zone of a 12-inch jet. The perturbed jet has a relatively flat radiated noise spectrum and an omi-directional intensity pattern. This is apparently due to an extensive reduction in quadrupole radiation with an increase in dipole radiation, the net result at high Mach number being favorable. The reduction in quadrupole noise is traced to a breaking up of the large structure in the mixing zone. (Author)

A72-34089 * # Correlation of total sound power and peak sideline OASPL from jet exhausts. U. H. von Glahn (NASA, Lewis Research Center, Jet Acoustics Branch, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-643.* 7 p. 8 refs. Members, \$1.50; nonmembers, \$2.00.

An empirical analysis of jet noise is made for convergent exhaust nozzles. This study, conducted at the Lewis Research Center, presents an engineering approach to the correlation of total sound power and maximum sideline OASPL (at 200 ft) for both subsonic and supersonic jets based on available data. Data correlation for subsonic jets shows no dependency of total sound power and maximum sideline OASPL on jet density. The analysis for supersonic jets results in a correlation parameter for jet total sound power consisting of the conventional Lighthill parameter modified by considerations of jet Mach number and jet acoustic velocity. Similar parameters also correlate the maximum sideline OASPL for supersonic jets. (Author)

A72-34090 # Flow, thrust, and acoustic characteristics of 50 tubes with 50 shrouds supersonic jet noise suppressor. H. T. Nagamatsu and R. E. Sheer, Jr. (GE Research and Development Center, Schenectady, N.Y.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-642.* 16 p. 16 refs. Members, \$1.50; nonmembers, \$2.00. FAA-supported research.

A supersonic jet noise suppressor consisting of 50 tubes of various lengths and with a single and 50 hexagonal shrouds was investigated at a jet Mach number of 1.4. Optical photographs, radial

and axial flow surveys, piezoelectric pressure fluctuations, and acoustic data were obtained for the plain jet and multitubes with shrouds. The sonic location on the axis was decreased from 18.7 in. to 2 in. with 50 tubes. With the 6 in. long multishroud the Mach number at the shroud exits was approximately 0.85 with an overall sound power level reduction of approximately 20 dB. With 50 tubes the thrust loss was 3.34 percent with overall sound power reduction of 11.2 dB. With the addition of multishrouds, the thrust loss was 26.7 percent with a power reduction of 20.3 dB. (Author)

A72-34091 * # A systematic study of supersonic jet noise. J. F. Louis, R. P. Letty, and J. R. Patel (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 5th, Boston, Mass., June 26-28, 1972, Paper 72-641.* 13 p. 17 refs. Members, \$1.50; nonmembers, \$2.00. U.S. Department of Transportation Contract No. TSC-142; Grant No. NGL-22-009-383.

The acoustic fields for a rectangular and for an axisymmetric nozzle configuration are studied. Both nozzles are designed for identical flow parameters. It is tried to identify the dominant noise mechanisms. The other objective of the study is to establish scaling laws of supersonic jet noise. A shock tunnel is used in the investigations. Measured sound directivity, propagation direction of Mach waves obtained by shadowgraphs, and the slight dependence of the acoustic efficiency on the level of expansion indicate that Mach waves contribute significantly to the noise produced by a rectangular jet. G.R.

A72-34108 # UAC Karlsruhe - The operational concept for the civil/military integrated upper area control centre at Karlsruhe. C. Dieben. *Eurocontrol*, vol. 2, no. 5, 1972, p. 8-13.

The area control center at Karlsruhe, Federal Republic of Germany, is to provide air traffic control services for the upper airspace of Southern Germany. The air traffic characteristics of the area to be served are discussed together with the operational concept, aspects of civil and military integration, problems of sectorization, data sources, features of automation, and details regarding the building provided for the control center. The control center will receive primary and secondary radar data from four radar sites, which will provide information concerning the position, the identity, and the flight level of an aircraft. G.R.

A72-34109 # Mediator - The development of a joint civil/military ATC organisation at the London air traffic control centre, West Drayton. *Eurocontrol*, vol. 2, no. 5, 1972, p. 19-27.

The Mediator plan for civil and military ATC evolved from a decision made in 1962 to integrate two separate Defence and ATC development plans then in existence. The objectives of the Mediator plan are discussed together with details regarding the traffic to be controlled in the Mediator airspace, aspects of ATC organization, and information regarding the implementation of the Mediator plan. Questions of sectorization are considered together with operations room layout, control suite facilities, radar data sources, radar displays, flight plan processing, and communications. G.R.

A72-34136 Integrated inertial/VOR/DME-navigation with the aid of adjustment according to the method of least squares (Integrierte Inertial/VOR/DME-Navigation durch Ausgleichung nach der Methode der kleinsten Quadrate). K. Ramsayer (Stuttgart, Universität, Stuttgart, West Germany). *Ortung und Navigation*, no. 1, 1972, p. 69-91. 8 refs. In German.

Description of a method for updating an inertial navigation system (INS) by VOR/DME or TACAN. The geographical coordinates indicated by INS are transformed in short time intervals to slant range and bearing referring to that VOR/DME or TACAN

station for which range and bearing information is available. The computed values are compared with the corresponding measured values. The differences are explained by errors of latitude, longitude, speed, and course determined by INS, and by random errors of the measured quantities. As the errors of INS, which are taken into account, are changing slowly, it is possible to introduce mean values for these errors over intervals shorter than 10 min. These mean values are determined by a least square adjustment in such a way, that the square sum of the corrections of the measured ranges and bearings with consideration of the different weights is a minimum. (Author)

A72-34137 Collision avoidance devices (Geräte zur Kollisionsabwendung). J. L. Parsons. *Ortung und Navigation*, no. 1, 1972, p. 93-104. In German.

Description of a recently developed series of collision avoidance devices, and review of the results of flight tests of these devices. The instruments comprising the so-called SECANT system are discussed, including a collision course indicator, an adjacent flight indicator, a collision avoidance indicator, an automatic pilot, and a responder. The SECANT system is distinguished by the fact that it requires no expensive clocks on board the aircraft and requires no cadencing by radio from a ground station.

A.B.K.

A72-34138 Technical aspects and problems in connection with the use of the L band in a satellite system for air navigation support (Technische Aspekte und Probleme im Zusammenhang mit der Benutzung des L-Bandes in einem Satellitensystem zur Unterstützung der Luftnavigation). G. Quaglione and E. Vitali. *Ortung und Navigation*, no. 1, 1972, p. 105-131. 8 refs. In German.

Description of the essential technical and operational features of a hypothetical satellite-supported air navigation system employing the L band (from 1540 to 1660 MHz) for data transmission. Some comments are made concerning the portion of the overall system responsible for speech comprehension, the direction-finding accuracy in the L band is discussed, and the data channels and modulation procedures are described. A study is made of various phenomena which can affect systems operating in the L band, and calculations of the receiver noise temperature in the L band are presented. Some technical and economic considerations concerning data transmission from satellite to aircraft, from earth to satellite, and from aircraft to satellite are evaluated.

A.B.K.

A72-34143 Segregating the aircraft. B. Mayes. *Flight International*, vol. 101, June 15, 1972, p. 870a-873.

It is pointed out that various pressures have been working against the simple process of transferring passengers between aircraft and terminal buildings. The solution to these pressures has been to bring aircraft into direct connection with the buildings serving them by making use of flexible mobile bridges. However, several problems connected with this approach have led to design solutions, working basically on a 'separation' theory. The new approach involves total separation between aircraft and permanent buildings, allowing each to function independently with little cross-interference. Dulles Airport uses mobile lounges to transport passengers from terminal to aircraft. In another airport passengers will be shuttled from the central terminal building to hold-room clusters on an underground system of three dual-track automated 'jetcars.'

G.R.

A72-34144 Producing the right response. H. Cowin. *Flight International*, vol. 101, June 15, 1972, p. 877a, 878.

Jaguar flight controls comprise wing spoilers, slab tailplane, and rudder. All controls are fully powered, with no manual reversion. An auto-stabilization system, acting on tailplane, rudder, and spoilers is also included. A further stipulation regarding the auto-stabilization requires that no pilot retrimming action should be needed after switching the system on or off, regardless of flight conditions. In order to meet the unusually stringent specifications flight-control components were grouped into small, integrated actuator packages.

G.R.

STAR ENTRIES

N72-23991* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

THE ROLE OF FLUCTUATING FORCES IN THE GENERATION OF COMPRESSOR NOISE

Hanno H. Heller and Sheila E. Widnall Washington NASA May 1972 112 p refs

(Contract NAS1-9883)

(NASA-CR-2012; Rept-2160) Avail: NTIS HC \$3.00 CSCL 01A

The results of a theoretical and experimental study on the role of aerodynamically-induced fluctuating forces in the sound generation by axial-flow compressors are presented. Analytical models for the generation and radiation of sound by rotor/stator combinations were developed. For the experimental substantiation of the analytical results, the technology was developed to measure fluctuating forces directly on rotating airfoils using miniature differential-pressure sensors and FM telemetry. Under the assumption of full coherence of the force field on the blade, radiated sound power was predicted from the force measurements on blades and compared with measured sound power. Both broadband radiation from a single rotating airfoil and discrete frequency radiation due to interaction of multi-bladed stator/rotor configurations were investigated. The results indicate the necessity to obtain information on the details of the force field for accurate prediction of the radiated sound spectrum. Author

N72-23994* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

WIND TUNNEL TEST DATA FOR WING TRAILING VORTEX FLOW SURVEY

N. A. Chigier and V. R. Corsiglia May 1972 94 p refs (NASA-TM-X-62148) Avail: NTIS HC \$6.75 CSCL 01A

Data are presented on velocity measurements made with hot wire anemometers in the wake of a model of the CV-990 aircraft and a rectangular wing in the NASA-Ames 2.14x3.05 meter (7- by 10-foot) wind tunnels. Variables included angle of attack, tunnel speed and axial distance up to 12 chord lengths downstream from the wing trailing edge. Effects of deflecting trailing edge flaps and small spoiler panels are shown. Author

N72-23996* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

EFFECTS OF BODY SHAPE ON THE AERODYNAMIC CHARACTERISTICS OF AN ALL-BODY HYPERSONIC AIRCRAFT CONFIGURATION AT MACH NUMBERS FROM 0.65 TO 10.6

Walter P. Nelms, Jr. Washington May 1972 61 p refs (NASA-TN-D-6821; A-4297) Avail: NTIS HC \$3.00 CSCL 01A

An experimental investigation was conducted to determine the effects of several variations in body shape on the aerodynamic characteristics of an all-body hypersonic aircraft configuration. The basic configuration had a delta planform with an elliptic cone forebody and an afterbody of elliptic cross section terminating in a straight-line trailing edge. Variations in body shape included the ratio of maximum cross-sectional to body planform area, body leading-edge sweep, and forebody length ratio. In addition, the effects of a thin wing mounted on one of the bodies was

investigated, and the aerodynamic characteristics of just the forebodies of two of the configurations were determined. The models had no stabilizing surfaces or propulsion system packages. Ranges of angle of attack (-4 deg to +15 deg) and angle of sideslip (-4 deg to +8 deg) were investigated. Of the four complete bodies, the configuration with the lowest ratio of cross-sectional to body planform area had the highest maximum lift-drag ratio and the greatest level of longitudinal stability at most Mach numbers. All the configurations had positive longitudinal stability near maximum lift-drag ratio at most Mach numbers. With exception of the lowest subsonic Mach numbers, changes in body sweep angle and in forebody length ratio had only minor effects on maximum lift-drag ratio. Author

N72-24001* Boeing Co., Philadelphia, Pa. Vertol Div.
WIND TUNNEL TEST OF A POWERED TILT-ROTOR PERFORMANCE MODEL, VOLUME 5 Final Report, Jun. Dec. 1970

John P. Magee, Robert B. Taylor, Frank J. McHugh, Nelson Miller, and Leon N. DeLarm Oct. 1971 510 p

(Contract F33615-69-C-1577)

(AD-736824; D213-10000-5; AFFDL-TR-71-62-Vol-5) Avail: NTIS CSCL 01/3

Wind tunnel test data obtained with a full span, two prop. tilt rotor, powered model are reported. Data were taken in hover, transition and cruise flight conditions and include performance, stability and control and blade loads information. The effects of the rotors, tail surfaces and airframe on the performance and stability are isolated as are the effects of the airframe on the rotors. Predicted rotor frequencies were verified, both static and rotating, and since they influence rotor response characteristics, correlation for stability and blade load data is included. Author (GRA)

N72-24002* Boeing Co., Philadelphia, Pa. Vertol Div.
WIND TUNNEL TEST OF THE AERODYNAMICS AND DYNAMICS OF ROTOR SPINUP, STOPPING AND FOLDING ON A SEMISPAN FOLDING TILT ROTOR MODEL, VOLUME 7 Final Report, Jan. - Jul. 1971

Dirk VanWagensveld, Frank J. McHugh, Leon N. DeLarm, Walter L. Lapinski, and John P. Magee Oct. 1971 408 p

(Contract F33615-69-C-1577)

(AD-736825; D213-10000-7; AFFDL-TR-71-62-Vol-7) Avail: NTIS CSCL 01/3

Wind tunnel test data obtained with a 1/9-scale semispan, unpowered, dynamically-scaled Model 213 stowed/tilt rotor are reported. The objectives of the tests were to obtain aerodynamic, structural, and dynamics data during the spinup, feather and blade fold cycles of this vehicle. Author (GRA)

N72-24003* Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamics Research.

A GENERAL CLASS OF AIRFOILS CONFORMALLY MAPPED FROM A CIRCLE

Richard M. James 27 May 1971 92 p refs

(Contract F44620-70-C-0108; AF Proj. 9781)

(AD-738318; MDC-J5108; AFOSR-72-0370TR) Avail: NTIS CSCL 20/4

Exact or analytical solutions for flows about airfoils displaying certain prescribed features may require a special program incorporating many different features. To avoid unnecessary labor and simplify a much abused background of traditional 'exact' airfoils, the report presents a general mapping procedure and account of the supporting theory. Special features needed for a computer program and to describe limiting behavior are included for zero trailing-edge angle. In addition, a capability for generating exact solutions in the presence of an isolated external vortex simulating a slat is described and illustrated briefly. GRA

N72-24006 Stanford Univ., Calif.
SECOND-ORDER SINGULAR ARCS IN TRAJECTORY OPTIMIZATION Ph.D. Thesis

John Frederick Dixon 1971 101 p
 Avail: Univ. Microfilms Order No. 71-23498

The basic features of singular optimal control are explained briefly and the order of singularity is defined. As an example of the second-order junction phenomenon an analysis of an unsymmetrical version of the Fuller problem is presented. The surprisingly complex solution of this problem calls for the optimal control to alternate between the control bounds with a frequency which becomes infinite at an accumulation point as a second-order singular arc is joined. It is shown that only a very slight penalty in cost results if the infinite sequence of control switches is terminated after the first few switches in favor of a convenient suboptimal policy. It is demonstrated that a second-order singular arc appears in the solution of a minimum time ascent problem for supersonic aircraft, with thrust and drag treated as functions of altitude and speed only. In this formulation the time rate of change of flight path angle is the control. Intermediate thrust arcs occurring in the study of minimum fuel space trajectories are investigated. Dissert. Abstr.

N72-24007 Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
AIRCRAFT TRAJECTORY OPTIMISATION USING PONT-RYAGIN'S MINIMUM PRINCIPLE
 M. W. Winn Mar. 1971 67 p refs
 (Contract KV/B/627/CB.64(A))
 (ETN-4) Copyright. Avail: Issuing Activity

Theoretical derivation of Pontryagin minimum principles is discussed. A method for numerically solving the differential equations was developed, based on the gradient or steepest descent minimization procedure, incorporating a Runge-Kutta-Gill numerical integration routine. The method is applied to solving: (1) the minimum time heading change of an aircraft and (2) the coplanar minimum time intercept of a target aircraft by a chase aircraft. Author (ESRO)

N72-24008* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY NOISE TESTS OF THE ENGINE-OVER-THE-WING CONCEPT. 1: 30 DEG - 60 DEG FLAP POSITION
 Meyer Reshotko, William A. Olsen, and Robert G. Dorsch Mar. 1972 28 p refs
 (NASA-TM-X-68032) Avail: NTIS HC \$3.50 CSCL 01C

The results of preliminary acoustic tests of the engine over the wing concept are summarized. The tests were conducted with a small wing section model (32 cm chord) having two flaps set at the landing position, which is 30 and 60 deg respectively. The engine exhaust was simulated by an air jet from a convergent nozzle having a nominal diameter of 5.1 centimeters. Factors investigated for their effect on noise include nozzle location, wing shielding, flap leakage, nozzle shape, exhaust deflectors, and internally generated exhaust noise. Author

N72-24009* National Aeronautics and Space Administration, Washington, D.C.
TU-144 ON THE AIR LANES Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 1, 1972 p 16-17
 A. Kraminov May 1972 5 p
 (NASA-TT-F-14241) Avail: NTIS HC \$3.00 CSCL 01C

An interview with Soviet engineering personnel concerning the performance and characteristics of the TU-144 aircraft is presented. The document consists of subjective opinions of aircraft designers and engineers describing the operation, flight test, and construction of the aircraft. Author

N72-24010* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF A LARGE SCALE LIFT FAN TRANSPORT MODEL WITH PODDED FANS FORWARD AND LIFT CRUISE FANS MOUNTED ABOVE THE WING
 Jerry V. Kirk, Stanley O. Dickinson, Leo P. Hall, and Mary G.

Coffman Apr. 1972 132 p refs
 (NASA-TM-X-62151) Avail: NTIS HC \$8.75 CSCL 01B

The aerodynamic characteristics of a large scale V/STOL transport model powered by tip-turbine driven lift fans were investigated. The model had four fans; the forward fans were mounted in pods forward of the wing at midsemispan. The aft fans were placed in cruise nacelles behind and above the wing. A cascade of variable camber exit louvers was placed behind each of the lift-cruise fans to turn the fan flow in the lift direction for hover and transition to wing supported flight. The wing of the model was mounted above the fuselage, had an aspect ratio of 5.8, sweepback of 35 deg at the quarter chord line and a taper ratio of 0.3. Various configurations of the model were tested to explore the transition speed range. Fan performance, turning effectiveness of the variable camber exit louvers, longitudinal and lateral-directional characteristics with fan operation in crossflow are presented. Author

N72-24011* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE-SCALE WIND-TUNNEL INVESTIGATION OF THE NOISE CHARACTERISTICS OF A SEMISPAN WING EQUIPPED WITH AN EXTERNALLY BLOWN JET FLAP
 Michael D. Falarski May 1972 118 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab. (NASA-TM-X-62154) Avail: NTIS HC \$8.00 CSCL 01B

A wind tunnel investigation was made of the noise characteristics of a 4.42 m (14.5 foot) semispan, externally-blown jet flap model. The model was equipped with a single 76.2 cm (30 inch) diameter, ducted fan with a 1.03 pressure ratio. The effects of flap size, fan vertical location, and forward speed on the noise characteristics were studied. The data from the investigation is presented in the form of tabulated one-third octave band frequency spectrums and perceived noise levels for each test condition. Author

N72-24012* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT EVALUATION OF A VECTORED THRUST JET V/STOL AIRPLANE DURING SIMULATED INSTRUMENT APPROACHES USING THE KESTREL (XV-6A) AIRPLANE
 Samuel A. Morello, Lee H. Person, Jr., Robert E. Shanks, and Richard G. Culpepper Washington May 1972 78 p refs
 (NASA-TN-D-6791; L-8254) Avail: NTIS HC \$3.00 CSCL 01B

An in-flight investigation was made to determine the terminal-area operating problems of a vectored-thrust-jet vertical and short take-off landing (V/STOL) airplane under simulated instrument conditions. Handling-qualities data pertinent to the terminal-area approach and landing task are presented in the text, and additional documentation is included in the appendixes. Problems dealing with the cruise letdown to localizer capture, conversion to powered-lift flight, precise control of the glide slope, approach velocity or deceleration schedule, hover, and landing are discussed. Author

N72-24013* National Aeronautics and Space Administration, Washington, D.C.
AEROBUS: THE AIRCRAFT OF THE FUTURE (BASIC PROBLEMS OF DESIGNING AIR BUSES)
 V. Sheynin May 1972 9 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya, no. 1, 1972 p 24-27
 (NASA-TT-F-14240) Avail: NTIS HC \$3.00 CSCL 01B

The problems associated with the design of air bus type aircraft are discussed. The primary design problem is identified as the size and weight of the aircraft. Other problems involved in the aircraft configuration are concerned with the cross sectional shape of the fuselage, the location of the engines, accommodations for the passengers, and a compromise on the maximum cruise speed to be permitted during operation. The rationale behind various decisions for the air bus design are explained. Author

N72-24014* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE OF AN AIRCRAFT TIRE UNDER CYCLIC BRAKING AND OF A CURRENTLY OPERATIONAL ANTISKID BRAKING SYSTEM

John A. Tanner Washington May 1972 25 p refs (NASA-TN-D-6755; L-7640) Avail: NTIS HC \$3.00 CSCL 01B

An experimental investigation was conducted to study the performance of an aircraft tire under cyclic braking conditions and to study the performance of a currently operational aircraft antiskid braking system. Dry, damp, and flooded runway surface conditions were used in the investigation. The results indicated that under cyclic braking conditions the braking and cornering-force friction coefficients may be influenced by fluctuations in the vertical load, flexibility in the wheel support, and the spring coupling between the wheel and the tire-pavement interface. The cornering capability was shown to be negligible at wheel slip ratios well below a locked-wheel skid under all test surface conditions. The maximum available brake-force friction coefficient was shown to be dependent upon the runway surface condition, upon velocity, and, for wet runways, upon tire differences. Moderate reductions in vertical load and brake system pressure did not significantly affect the overall wet-runway performance of the tire.

Author

N72-24015* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYSIS OF VGH DATA FROM TWO TYPES OF FOUR-ENGINE AIRPLANES IN COMMERCIAL CARGO SERVICE

Frederick M. Healy Washington May 1972 27 p refs (NASA-TN-D-6790; L-8262) Avail: NTIS HC \$3.00 CSCL 01B

Data are presented for derived gust velocities and for incremental normal accelerations due to gusts, maneuvers, and landing impacts. The data were obtained from NASA VGH recorders installed on three four-engine cargo airplanes operated by three airlines. Continental United States and trans-Pacific routes were covered.

Author

N72-24016* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT CALIBRATION OF COMPENSATED AND UNCOMPENSATED PITOT-STATIC AIRSPEED PROBES AND APPLICATION OF THE PROBES TO SUPERSONIC CRUISE VEHICLES

Lannie D. Webb and Harold P. Washington Washington May 1972 43 p refs (NASA-TN-D-6827; H-665) Avail: NTIS HC \$3.00 CSCL 01D

Static pressure position error calibrations for a compensated and an uncompensated XB-70 nose boom pitot static probe were obtained in flight. The methods (Pacer, acceleration-deceleration, and total temperature) used to obtain the position errors over a Mach number range from 0.5 to 3.0 and an altitude range from 25,000 feet to 70,000 feet are discussed. The error calibrations are compared with the position error determined from wind tunnel tests, theoretical analysis, and a standard NACA pitot static probe. Factors which influence position errors, such as angle of attack, Reynolds number, probe tip geometry, static orifice location, and probe shape, are discussed. Also included are examples showing how the uncertainties caused by position errors can affect the inlet controls and vertical altitude separation of a supersonic transport.

Author

N72-24017* National Transportation Safety Board, Washington, D.C.

BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING CORPORATE /EXECUTIVE AIRCRAFT: US GENERAL AVIATION, 1970

Jun. 1972 42 p (NTSB-AMM-72-5) Avail: NTIS HC \$4.25

Aircraft accidents involving corporate executive type aircraft in U.S. general aviation during calendar year 1970 are reported.

The reports contain statistical, cause/factor and injury tables, accident rates, and pilot qualification data.

Author

N72-24018* National Transportation Safety Board, Washington, D.C.

BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING AIR TAXI OPERATIONS: US GENERAL AVIATION, 1970

Jun. 1972 93 p (NTSB-AMM-72-4) Avail: NTIS HC \$6.75

Aircraft accidents involving air taxi operations in U.S. general aviation for calendar year 1970 are reported. The reports contain statistical, cause/factor and injury tables, accident rates, and pilot qualification data.

Author

N72-24019* National Transportation Safety Board, Washington, D.C.

BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING ROTORCRAFT: US GENERAL AVIATION, 1970

Jun. 1972 123 p (NTSB-AMM-72-3) Avail: NTIS HC \$8.25

Aircraft accidents involving rotorcraft in U.S. general aviation for calendar year 1970 are reported. The reports are based on statistical cause/factor and injury aspects, accident rates, and pilot qualification information.

Author

N72-24020* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TABULATED PRESSURE MEASUREMENTS ON A LARGE SUBSONIC TRANSPORT MODEL AIRPLANE WITH HIGH BYPASS RATIO, POWERED, FAN JET ENGINES

Stuart G. Flechner and James C. Patterson, Jr. Washington May 1972 345 p refs (NASA-TM-X-2530; L-8182) Avail: NTIS HC \$3.00 CSCL 01B

An experimental wind-tunnel investigation to determine the aerodynamic interference and the jet-wake interference associated with the wing, pylon, and high-bypass-ratio, powered, fan-jet model engines has been conducted on a typical high-wing logistics transport airplane configuration. Pressures were measured on the wing and pylons and on the surfaces of the engine fan cowl, turbine cowl, and plug. Combinations of wing, pylons, engines, and flow-through nacelles were tested, and the pressure coefficients are presented in tabular form. Tests were conducted at Mach numbers from 0.700 to 0.825 and angles of attack from -2 to 4 deg.

Author

N72-24022* Federal Aviation Administration, Oklahoma City, Okla. National Flight Inspection Div.

EVALUATION OF EXECUTIVE JET APPROACH ANGLES Final Report

Frank Parr Apr. 1972 73 p (FAA-FS-600-7) Avail: NTIS HC \$5.75

Evaluations were flown in the Aero Jet Commander, Gates Lear Jet, North American Sabreliner, and Lockheed JetStar. Approach slope angles were varied from approximately 3 degrees up to almost 7 degrees. Flight parameters were measured in the areas of descent airspeed, power requirements in flare, flyability, sink rates, threshold crossing heights, and touchdown distances. Objective and subjective measurements were made. It was found that when approach slope angles above 4 degrees (approximate minimums of 400 feet altitude - 1 mile visibility) were used they were accompanied by problems of power requirement, flyability, high sink rates, and long touchdown distances.

Author

N72-24023* Scientific Translation Service, Santa Barbara, Calif.

DURABILITY STUDIES ON COMPONENTS OF THE VFW-H3 GYRODYNE

W. Paul Washington NASA May 1971 22 p Transl. into ENGLISH from the publ. "Betriebsfestigkeitsprobleme bei

Hubschrauben" Stuttgart, DGLR, Dec. 1970 . p 124-156
Presented at DGLR Symp. on Helicopters and Propellers,
Immenstaad, West Germany, 24 Jun. 1969
(Contract NASw-2035)
(NASA-TT-F-14284) Avail: NTIS HC \$3.25 CSCL 01B

As part of the development of the VFW H3/H5 gyrodyne family, various durability tests were performed. One of the major objectives was demonstration of satisfactory confidence that the rotor blades and their connections would not fatigue. Author

N72-24024* Michigan Univ., Ann Arbor.
AN EVALUATION OF STRING THEORY FOR THE PREDICTION OF DYNAMIC TIRE PROPERTIES USING SCALE MODEL AIRCRAFT TIRES

S. K. Clark, R. N. Dodge, and G. H. Nybakken Washington
NASA Jun. 1972 54 p refs
(Grant NGL-23-005-010)

(NASA-CR-2058; Rept-056080-18-T) Avail: NTIS HC \$3.00 CSCL 01B

The string theory was evaluated for predicting lateral tire dynamic properties as obtained from scaled model tests. The experimental data and string theory predictions are in generally good agreement using lateral stiffness and relaxation length values obtained from the static or slowly rolling tire. The results indicate that lateral forces and self-aligning torques are linearly proportional to tire lateral stiffness and to the amplitude of either steer or lateral displacement. In addition, the results show that the ratio of input excitation frequency to road speed is the proper independent variable by which frequency should be measured. Author

N72-24025* Boeing Co., Philadelphia, Pa. Vertol Div.
ACCEPTABILITY OF VTOL AIRCRAFT NOISE DETERMINED BY ABSOLUTE SUBJECTIVE TESTING

Harry Sternfeld, Jr., Ernest G. Hinterkeuser, Roy B. Hackman, and Jerry Davis Washington NASA Jun. 1972 90 p refs
(Contract NAS1-10044)

(NASA-CR-2043; D-210-10392-1) Avail: NTIS HC \$3.00 CSCL 01C

A program was conducted during which test subjects evaluated the simulated sounds of a helicopter, a tilt wing aircraft, and a 15 second, 90 PNdB (indoors) turbojet aircraft used as reference. Over 20,000 evaluations were made while the test subjects were engaged in work and leisure activities. The effects of level, exposure time, distance and aircraft design on subjective acceptability were evaluated. Some of the important conclusions are: (1) To be judged equal in annoyance to the reference jet sound, the helicopter and tilt wing sounds must be 4 to 5 PNdB lower when lasting 15 seconds in duration. (2) To be judged significantly more acceptable than the reference jet sound, the helicopter sound must be 10 PNdB lower when lasting 15 seconds in duration. (3) To be judged significantly more acceptable than the reference jet sound, the tilt wing sound must be 12 PNdB lower when lasting 15 seconds in duration. (4) The relative effect of changing the duration of a sound upon its subjectively rated annoyance diminishes with increasing duration. It varies from 2 PNdB per doubling of duration for intervals of 15 to 30 seconds, to 0.75 PNdB per doubling of duration for intervals of 120 to 240 seconds. Author

N72-24026* Royal Aircraft Establishment, Farnborough (England).

A FLIGHT INVESTIGATION OF A STOL AIRCRAFT

Jiro Koo, Tolchi Oka, Yukichi Tsukana, Yukio Kamata, and Takatsuga Ono Oct. 1971 26 p refs Transl. into ENGLISH from Japan Natl. Aerospace Lab. report TM-146, Aug. 1968 (RAE-Lib-Trans-1604; BR28945; TM-146) Avail: NTIS HC \$3.50

The take-off and landing characteristics of a STOL were investigated to point out the factors limiting the STOL operation. To evaluate the STOL performance, the operational envelope and the time history of STOL take-off and landing were demonstrated. Author

N72-24028* Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugmechanik der Luftfahrzeuge.

ON THE INFLUENCE OF LIFT ENGINE ARRANGEMENT ON THE EIGENMOTION OF LIFT JET POWERED VTOL AIRCRAFT IN HOVERING FLIGHT [UEBER DEN EINFLUSS DER HUBTRIEBWERKSANORDNUNG AUF DIE EIGENBEWEGUNG STRAHLGESTUETZTER VTOL-FLUGZEUGE IM SCHWEBEFLUG]

Dietrich Hanke 1971 51 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-112) Avail: NTIS HC \$4.75; DFVLR, Porz 12.50 DM

The influence of lift engine arrangement on the stability of lift jet powered VTOL-aircraft in hovering flight is investigated. To that end, the forces and moments occurring at the inlet in consequence of the air masses sucked in by the engines are computed by means of the momentum theory. Furthermore, the engine derivatives are derived and equations of motion for hovering flight are defined. For eight VTOL configurations with different lift engine arrangement, the eigenvalues of the coupled longitudinal and lateral motion are computed. The vertical distance of engine inlets from the center of gravity of the aircraft proves to be the essential stability parameter. Author (ESRO)

N72-24030* Army Air Mobility Research and Development Lab., Fort Eustis, Va.

DYNAMIC RESPONSE OF THE OV-1A AIRCRAFT TO SOFT FIELD LANDINGS Final Report, Jul. - Aug. 1967

William T. Alexander Oct. 1971 140 p refs

(DA Proj. 1F1-62204-A-146)

(AD-737752; USAAMRDL-TR-71-62) Avail: NTIS CSCL 01/3

The report presents the ground loads measured on an instrumented OV-1 airplane during landings on smooth and rough fields. Test results for three landings are compared with the results of dynamic loads computations performed on a digital computer. The computing program is also used to calculate the loads which would have been obtained by landings and rollouts on the roughest portions of two fields whose contours were measured. Failing loads were obtained on one field only. The equations of motion for the computer program are presented. Recommendations are made for future investigations that will improve the analytical procedures. Author (GRA)

N72-24031* European Research Office, London (England).

THE FAS.2 HELICOPTER STABILIZER, FERRANTI INTERNATIONAL NEWS, AUTUMN 1971

Richard L. Scharpf 1971 4 p ref

(AD-737707; ERO-2-1972) Avail: NTIS CSCL 01/3

The report is based on an article published in the autumn issue, 1971, of 'Ferranti International News.' The article describes Ferranti autostabilizer developed for helicopters. It is an add-on system of electromechanical design which provides short term attitude holding to relieve the pilot of having to continuously stabilize the helicopter. GRA

N72-24032* Technology, Inc., Dayton, Ohio.

FLIGHT LOADS INVESTIGATION OF OH-6A HELICOPTERS OPERATING IN SOUTHEAST ASIA

F. Joseph Giessler, Larry E. Clay, and John F. Nash Oct. 1971 242 p refs

(Contract DAAJ02-70-C-0026; DA Proj. 1F1-62204-A-146)

(AD-738202; USAAMRDL-TR-71-60) Avail: NTIS CSCL 01/3

From structural flight loads measurements on three OH-6A helicopters, 216 hours of usable multichannel flight data were reworded as the helicopters operated from bases in Southeast Asia. Data were processed and analyzed according to four flight phases, called mission segments: ascent, maneuver, descent, and steady state. Data are presented in the form of time and occurrence tables, histograms, and exceedance curves. Author (GRA)

N72-24033# Boeing Co., Philadelphia, Pa. Vertol Div.
ADVANCED GEOMETRY, GLASS-FIBER REINFORCED PLASTIC ROTOR BLADE TEST PROGRAM Final Technical Report, Jun. 1967 - Feb. 1971

Donald J. Hoffstedt Sep. 1971 456 p refs
 (Contract DAAJ02-67-C-0072; DA Proj. 1F1-63204-D-157)
 (AD-738203; D210-10079-1; USAAMRDL-TR-71-42) Avail: NTIS CSCL 01/3

The report presents the results of a program to design, tool, fabricate, bench test, and flight test glass-reinforced epoxy rotor blades. Blade design used S-glass reinforced epoxy, a mechanically trapped and bonded titanium root end attachment, and aerodynamic contours employing advanced airfoils, thickness taper, and planform taper. Fiberglass tooling was successfully employed, and fabrication and quality assurance techniques were developed for the prototype quantity of 12 rotor blades. Static and fatigue tests were conducted for both rotor blade elements and full-scale structure, and whirl test demonstration was completed. Exploratory flight testing was performed on a CH-47C prototype instrumented aircraft used as a test-bed.

GRA

N72-24034# Federal Aviation Administration, Washington, D.C.
AVIATION FORECASTS: FISCAL YEARS 1972 - 1983
 Sep. 1971 51 p

(AD-738360) Avail: NTIS CSCL 01/2

Contents: Highlights of Fiscal Year 1971; Aviation industry forecasts (Air carrier traffic, Air carrier fleet, General aviation flying and aircraft fleet, Domestic aviation fuel consumption, Civil aircraft and engine production); FAA air traffic activity forecasts (Aircraft operations at airports with FAA traffic control service, FAA en route traffic control activity, FAA flight services); Airmen forecasts (Number of active pilots).

GRA

N72-24035# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.

FLIGHT CALIBRATION TESTS OF F-8 AIRCRAFT FOR OPTIMAL ENERGY CLIMBS Final Technical Report, 1 Mar. - 30 Oct. 1971

D. C. Sederstrom Feb. 1972 93 p refs
 (Contract N00014-71-C-0274; NR Proj. 213-081)
 (AD-738018; Rept-12653-F(R)) Avail: NTIS CSCL 01/2

An F8 energy management flight test based on use of the energy state approximation and on test aircraft data for computation of minimum time energy climbs is described. Three types of climbs were made: Handbook climbs with level accelerations, an optimum climb path computed from published data and an optimal climb path determined from data obtained in the flight tests. Comparisons of these climbs are presented. Effects of ambient temperature, a major factor in the practical use of energy management, are discussed. Author (GRA)

N72-24036# North American Rockwell Corp., Columbus, Ohio.
STUDY OF CONTROL DEVICES FOR IMPROVED TACTICAL AGILITY Final Report

R. H. Hanna and Vearl R. Stewart Aug. 1971 96 p refs
 (Contract N00014-71-C-0062; NR Proj. 212-202)
 (AD-737694; NR71H-317) Avail: NTIS CSCL 01/3

A study was conducted to determine the effect of the control device characteristics on airplane agility at transonic speeds. A list of over 600 reports containing data on various control devices is presented. A discussion of the more widely used control devices is presented together with data showing trends and general characteristics. From this list of control devices certain devices were selected for evaluation on a baseline configuration. An Agility Index was formulated for the evaluation of the selected control devices. The results of this portion of the study showed certain control devices than enhanced agility. A fighter aircraft was configured with the agility enhancement control devices, evaluated for agility and compared to the baseline airplane. Author (GRA)

N72-24118# Joint Publications Research Service, Arlington, Va.
SOME CHARACTERISTICS OF THE HYDRODYNAMICS OF AN ENGINE OF THE FLAPPING WING TYPE

Yu. K. Savchenko *In its Bionics* 15 May 1972 p 10-22 refs

Avail: NTIS HC \$12.75

Characteristics and advantages of a flapping wing engine patterned after wings found in nature are described, based on results obtained in an investigation of the hydrodynamics of a flapping wing on a specially designed oscillatory apparatus. A mathematical analysis of the kinematics is presented. The results of an approximation of the induced velocities from the eddy wakes of a flapping wing and a screw engine indicate that the losses in creating induced velocities in the entire variable range of the stepped angle are greater for a screw than for a wing.

K.P.D.

N72-24193# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

PENNSYLVANIA-PRINCETON ARMY AVIONICS RESEARCH PROGRAM. ARMY AIRCRAFT COMMUNICATION TASK Final Technical Report

Fred Haber Ft. Monmouth, N. J. ECOM Dec. 1971 181 p refs

(Contract DA-28-043-AMC-02411(E); DA Proj. 1H1-62202-A-219)

(AD-738178; Rept-72-13; ECOM-02411-26) Avail: NTIS CSCL 17/2

The objective was to pursue Army Aircraft requirements anticipated in the 1970-1980 time interval, including requirements for navigation, identification, and landing systems; the use of random access techniques; experiment on, and analysis of, the propagation environment of Army aircraft; and methods for reducing effects of fading resulting from strong specular reflections. Author (GRA)

N72-24335*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INITIAL OPERATING EXPERIENCE WITH AN AIRCRAFT SIMULATOR HAVING EXTENSIVE LATERAL MOTION

Richard S. Bray May 1972 27 p refs
 (NASA-TM-X-62155) Avail: NTIS HC \$3.50 CSCL 14B

The flight simulation facility features an extensive cockpit motion system, emphasizing lateral motion for the simulation of lateral-directional control tasks. The motion capabilities of the simulator are briefly described, and the logic with which the motion drives are controlled to provide the most effective approximations of the motions of flight is discussed. Preliminary assessments of the effectiveness of these motions, in the simulation of large transport aircraft, are discussed. Author

N72-24337# Committee on Interstate and Foreign Commerce (U. S. House).

AIRPORT AND AIRWAY TRUST FUND

Washington GPO 1971 118 p refs Hearings on H.R. 7072 (and identical bills) before Comm. on Interstate and Foreign Com., 92d Congr., 1st Sess., 8-9 Jun. 1971

Avail: NTIS Avail: Subcomm. on Transportation and Aeronautics

Amendments to the Airport and Airway Development and Revenue Acts are considered in order to clarify priorities such as modernization and expansion. G.G.

N72-24338# Federal Aviation Administration, Washington, D.C.
SITING CRITERIA FOR INSTRUMENT LANDING SYSTEMS
 7 Jun. 1971 182 p

(DOT-FAA-6750.16) Avail: NTIS HC \$11.25

Criteria for the installation of instrument landing systems are presented. The choice of the runway to be served is based on the following factors: (1) runway length and width, (2) compliance with minimum obstruction clearance regulations, (3) alignment with respect to the prevailing low visibility wind, (4) orientation with respect to the traffic approaches of the airport and the airways concerned, and (5) missed approach

procedure. The effects of siting on the operation of the instrument landing system are examined. Typical instrument landing system installations are illustrated. Author

N72-24343# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

A FREE-FLIGHT SUPPORT SYSTEM

Akira Azuma, Bunji Tomita (Natl. Space Develop. Agency of Japan), Matsusaburo Iuchi, Hideo Mishima (Shimadzu Seisakusho Ltd.), Tadami Iwata (Shimadzu Seisakusho Ltd.), and Akira Komoto (Shimadzu Seisakusho Ltd.) Mar. 1972 36 p refs (ISAS-477-Vol-37-No-3) Avail: NTIS HC \$4.00

A support system for a free flight test facility to simulate V/STOL and helicopter flight is discussed. The system consists of a free flight follower and a data reduction system. The flight path and attitude angles of the model during flight are sensed with potentiometers and recorded in oscillograms. A miniature computer and an analog to digital converter are included as part of the support system. Author

N72-24344# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

DETERMINATION OF NOISE EXPOSURE AROUND AN AIRPORT

Juichi Igarashi and Gen Nishinomiya (Japan Broadcasting Corp.) Mar. 1972 18 p refs (ISAS-476-Vol-37-No-2) Avail: NTIS HC \$3.00

A study of drawing the noise exposure contour around an airport is presented. The contour was figured out from measured data obtained in the vicinity of Osaka airport. It is compared with the calculated contour based on data of FAA, the specified flight paths and scheduled operations similar to those of the period of measurements. The methods of determination of PNdb, duration and tone corrections are also mentioned together with the relation between PNdb and db(D) or db(A). Author

N72-24352# Federal Aviation Administration, Washington, D.C. OPERATIONS UNDER THE AIRPORT AND AIRWAY DEVELOPMENT ACT Annual Report, fiscal year ending 30 Jun. 1971

30 Jun. 1971 46 p (AD-737040; AR-2) Avail: NTIS CSCL 01/5

The Airports Program is based primarily on the provisions of the Airport and Airway Development Act of 1970 (Public Law 91-258) enacted on 21 May 1970. Principal activities of this program include preparation of a National Airport System Plan, administering programs of grants-in-aid for airport planning and airport development; development and application of airport planning, engineering and safety standards; airport certification and inspection for safety of operations; field collection of information for the airport data program; participation in transfer of Federal land and property for civil airport use; and the program for assuring compliance and enforcement of airport agreements. Author (GRA)

N72-24353# Office of Naval Research, London (England).

EUROPEAN SCIENTIFIC NOTES, VOLUME 26, NUMBER 1 Seymour Hess and Victoria Hewitson 31 Jan. 1972 31 p refs (AD-737607; ONRL-26-1) Avail: NTIS CSCL 14/2

The report is a monthly publication presenting brief articles concerning recent developments in European scientific research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by disclosing interesting information well in advance of the usual scientific publications. The articles are written by members of the scientific staff of ONRL, with an occasional article contributed by a visiting stateside scientist. Author (GRA)

N72-24357# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. TOTAL IN-FLIGHT SIMULATOR (TIFS), PRELIMINARY DESIGN REPORT Final Report, Nov. 1966 - Jun. 1967

Wright-Patterson AFB, Ohio AFFDL Aug. 1971 262 p refs (Contract F33615-67-C-1157; AF Proj. 6848)

(AD-738314; AFFDL-TR-71-119) Avail: NTIS CSCL 14/2

The TIFS research airplane, the most advanced in-flight simulation vehicle yet developed, was designed to provide Total In-Flight Simulation. This capability depends on two basic features of the aircraft. First is the addition of an evaluation cockpit which is entirely separate from the normal airplane's safety pilot's cockpit. Second is the control by a variable stability system of not only the moments about all three axes, but also the forces acting along the three axes. The report describes the TIFS airplane development during the period from November 1966 to June 1967. Author (GRA)

N72-24359 Stanford Univ., Calif.

AN ANALYSIS OF A TWO-DIMENSIONAL PROPULSION WING Ph.D. Thesis

Galen Hu 1971 120 p

Avail: Univ. Microfilms Order No. 71-23518

A numerical method of solution using distributed surface singularities was developed to solve the potential flow problem of a two-dimensional airfoil with distributed suction over part of its upper surface and a thin jet issuing from a general point of the lower surface. The fluid at the trailing edge is assumed to separate as a free streamline forming a constant pressure wake region between it and the jet. The shapes of the free streamline and the jet, a priori unknown, constitute part of the solution. Several cases were calculated for different jet strengths with or without suction. The agreement of the numerical results with some limited experimental data with a jet, but no suction, is fair. This might be partly attributed to leading edge separation observed during the experiment. Dissert. Abstr.

N72-24368# National Aerospace Lab., Amsterdam (Netherlands). ON A KERNEL-FUNCTION METHOD FOR THE CALCULATION OF PRESSURE DISTRIBUTIONS ON WINGS WITH HARMONICALLY OSCILLATING CONTROL SURFACES IN SUBSONIC FLOW

R. J. Zwaan 3 Aug. 1971 54 p refs Supersedes NLR-TR-70122-U

(NLR-TR-70123-U; NLR-TR-70122-U) Avail: NTIS HC \$4.75

Local solutions for the pressure distribution at the leading and side edges of harmonically oscillating unbalanced control surfaces have been fitted into an existing lifting surface method for wings without control surfaces. Calculated results are compared with results of other methods and with experiments. Author

N72-24394# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AIRPLANE STABILITY FOR FLIGHT WITH CONSTANT ANGULAR VELOCITY AROUND THE LONGITUDINAL AXIS Milorad Pastrakuljic 29 Nov. 1971 11 p refs Transl. into ENGLISH from Navchno-Tehnicky Pregled (Yugoslavia), v. 20, no. 5, 1970 p 37-41

(AD-738231; FTD-HC-23-829-71) Avail: NTIS CSCL 20/4

The paper considers the effects of longitudinal acceleration and magnus forces and moments on stability of aircraft having single plane of symmetry and gives expressions allowing estimation of cases when such effects should be taken into account. Author (GRA)

N72-24498# National Defense Research Organization TNO, Rijswijk (Netherlands).

AN APPARATUS FOR THE AUTOMATED RECORDING OF INFRARED SPECTRA OF GASEOUS SAMPLES FROM LIQUID OXYGEN

F. H. Meppelder Jul. 1971 24 p ref

(CL-1971-16; TDCK-58312) Avail: NTIS HC \$3.25

An electromechanical device is described which automatically performs the manipulations necessary for recording the infrared spectra of a series of gaseous oxygen samples. A spectrum of each sample at 10 atm, or any other adjustable lower value and a spectrum at 1 atm, are recorded. The reliability of the

apparatus is such that a series of 10 samples can be handled unattended. The automate was developed for the analysis of trace contaminants in aviator's breathing oxygen; some other fields of application are indicated. Author

N72-24530* Boeing Co., Seattle, Wash.

APPLICATION OF POLYIMIDE ACTUATOR ROD SEALS

A. W. Watermann, B. F. Gay, E. D. Robinson, S. K. Srinath, and W. G. Nelson 30 Jan. 1972 177 p refs

(Contract NAS3-14317)

(NASA-CR-120878; D6-54351) Avail: NTIS HC \$11.00 CSCL 11A

Development of polyimide two-stage hydraulic actuator rod seals for application in high-performance aircraft was accomplished. The significant portion of the effort was concentrated on optimization of the chevron and K-section second-stage seal geometries to satisfy the requirements for operation at 450 K (350 F) with dynamic pressure loads varying between 200 psig steady-state and 1500 psig impulse cycling. Particular significance was placed on reducing seal gland dimension by efficiently utilizing the fatigue allowables of polyimide materials. Other objectives included investigation of pressure balancing techniques for first-stage polyimide rod seals for 4000 psig 450 K (350 F) environment and fabrication of a modular retainer for the two-stage combination. Seals were fabricated in 0.0254 m (.10in.) and 0.0635 m (2.5in.) sizes and tested for structural integrity, frictional resistance, and endurance life. Test results showed that carefully designed second stages using polyimides could be made to satisfy the dynamic return pressure requirements of applications in high-performance aircraft. High wear under full system pressure indicated that further research is necessary to obtain an acceptable first-stage design. The modular retainer was successfully tested and showed potential for new actuator applications. Author

N72-24531* Scientific Translation Service, Santa Barbara, Calif.

DETERMINATION OF THE LIFETIME OF HELICOPTER COMPONENTS

R. Prinz Washington NASA May 1972 77 p refs Transl. into ENGLISH from Proc. of DGLR Symp. on Helicopters and Propellers, Immenstaad, West Germany, 24 Jun. 1969 (Contract NASw-2035)

(NASA-TT-F-14280) Avail: NTIS HC \$6.00 CSCL 14D

Methods which are used, or are to be used in the future, for determining the lifetime of helicopter components are discussed. These methods are based on the determination of the working stress. Calculated or measured stress-time functions are studied, and both analytical and experimental methods are given for the statistical evaluation of these functions. The use of a unit collective for fatigue studies on rotor blades is also recommended, on the basis of various stress collectives reported in the bibliography. This unit collective can serve as the basis for fatigue studies. Some possibilities for carrying out fatigue studies are stated, and the necessity for statistical evaluation of test results is mentioned. Some methods for determining lifetime on the basis of the fluctuating stresses are presented. Author

N72-24541* Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

PUMPS, LIQUID

7 Feb. 1972 7 p refs

(AD-737713; TOP-9-3-314) Avail: NTIS CSCL 13/11

The report describes a method for evaluation of liquid pump operational and functional performance characteristics. Supporting tests, facilities, and equipment required are identified, and procedures for functional performance tests are provided. Author (GRA)

N72-24542* Martin Marietta Corp., Denver, Colo.

CENTER FOR HIGH ENERGY FORMING Interim Report

I. R. Kramer, Jimmy D. Mote (E. F. Industries, Inc., Louisville, Colo.), and Arthur A. Ezra (Denver Univ.) Jan. 1972 28 p

(Contract DA-19-066-AMC-266(X))

(AD-737719; AMMRC-CR-66-05/30) Avail: NTIS CSCL 13/8

A description is given of the areas in applied research where definite programs pointed toward hardware applications are already established. These include thick walled tube expansion, die stresses, and applications of explosive welding to hardware configurations. The work on explosive expansion of thick walled tubes is directed toward reduction of process cost and an accurate determination of the process economics. Explosive compaction of metal powders is directed toward production of forging preforms for turbine discs, turbine buckets, etc. The explosive welding work will concentrate on the production of components applicable to helicopter spars, rotors, hubs, and dual hardware armor. Author (GRA)

N72-24544* Bendix Corp., Southfield, Mich.

TESTING OF A PNEUMATIC SERVOMECHANISM Final Report, Oct. 1967 - Mar. 1971

Kenneth W. Verge and Ronald G. Read Wright-Patterson AFB, Ohio AFFDL Feb. 1972 201 p

(Contract F33615-67-C-1196; AF Proj. 8226)

(AD-738345; RLD-5462; AFFDL-TR-71-146) Avail: NTIS CSCL 13/7

A unique low pressure pneumatic, high torque rotary actuation technique applicable to aircraft primary or standby flight control is described. This drive, the Bendix Dynavector actuator, incorporates an integrated captive vane orbital pneumatic motor with a high ratio epicyclic transmission. The demonstration of this rotary actuator technology has been accomplished by the design, fabrication and testing of two 10,000 lb-in torque capacity drives designated models PH-391-U1 and U2. Author (GRA)

N72-24547* Dynamic Science, Phoenix, Ariz.

EVALUATION OF SELF-SEALING BREAKAWAY VALVES FOR CRASHWORTHY AIRCRAFT FUEL SYSTEMS Final Report

Bruce Anson Fort Eustis, Va. USAAMRDL Nov. 1971 75 p

(Contract DAAJ02-70-C-0038; DAAJ02-67-C-0004; DA Proj. 1F1-64204-D-154)

(AD-738204; Rept-4820-71-25; USAAMRDL-TR-71-65) Avail: NTIS CSCL 13/11

A program was aimed at improving the component performance characteristics of breakaway valves used to eliminate fuel spillage and subsequent fire in otherwise survivable aircraft crashes. It consisted of an initial study and literature survey to establish the state of the art followed by two series of static and dynamic tests of various types of valves to define problem areas and to verify that the problems had been corrected. An analysis to correct the indicated deficiencies was accomplished between the two test phases. The results were then collated into a draft military specification. GRA

N72-24585* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COMPARISON OF EXPERIMENTAL AND THEORETICAL THERMAL FATIGUE LIVES FOR FIVE NICKEL BASE ALLOYS

David A. Spera [1972] 12 p refs Presented at Symp. on Fatigue at Elevated Temp., Storrs, Conn., 18-23 Jun. 1972

(NASA-TM-X-68051; E-6852) Avail: NTIS HC \$3.00 CSCL 11F

The alloys Nimonic 90, IN 100, coated IN 100, B 1900, coated B 1900, MAR M200, and MAR M200DS (directionally solidified) were studied. Maximum temperatures ranged from 770 C to 1120 C (1420 F to 2050 F). Specimen geometries included tapered disks, double-edged wedges, and cambered airfoils. The disks and wedges were heated and cooled in fluidized beds. The airfoil specimens were heated by a Mach 1 natural gas burner and rapid-air-cooled, with and without spanwise loading. Life calculations included two distinct failure modes: conventional low cycle fatigue and cyclic creep. Required material properties were limited to conventional thermal, tensile,

and creep rupture data. The complete life calculation system included the calculation of transient temperature distributions, thermal strains, stresses, creep damage, fatigue damage, and cycles to first crack. Calculated lives were within a factor of two for 76 of the 86 data points analyzed. Cyclic creep accounted for 81% of all the calculated damage. Author

N72-24601# Battelle Memorial Inst., Columbus, Ohio. Metals and Ceramics Information Center.

CRACK BEHAVIOR IN D6AC STEEL: AN EVALUATION OF FRACTURE MECHANICS DATA FOR THE F-111 AIRCRAFT

C. E. Feddersen, D. P. Moon, and W. S. Hyler Jan. 1972 201 p refs Sponsored by the AF (AD-737779; MCIC-72-04) Avail: NTIS CSCL 11/6

A multilaboratory experimental program was conducted to determine the fracture toughness, fatigue-crack propagation, and sustained-load crack behavior of the D6AC steel plate and forging materials used in the F-111 aircraft. The purpose of this effort was to assess crack behavior in D6AC steel in accordance with the principles of elastic fracture mechanics, such that adequate information would be available to predict the structural inspection intervals required for the F-111 aircraft. Author (GRA)

N72-24608# Joint Publications Research Service, Arlington, Va. **INVESTIGATION OF THE INFLUENCE OF OXIDATION RESISTANT COATINGS ON THE FATIGUE STRENGTH OF HEAT RESISTANT ALLOY**

I. I. Ishchenko, V. I. Omelchenko, B. N. Sinayskiy, A. D. Pogrebnyak, P. S. Banas, and M. I. Reznik 12 May 1972 11 p refs Transl. into ENGLISH from Prob. Prochnosti (USSR), no. 10, 1971 p 76-81 (JPRS-55972) Avail: NTIS HC \$3.00

Data are presented on the influence of certain types of oxidation-resistant coatings on the fatigue strength of the nickel-based alloy ZhS6K, which is extensively used for vanes of aviation turbine engines. It is concluded that oxidation-resistant coatings (powder calorizing, calorizing, and aluminosirconizing with paint) had no influence on the fatigue strength of ZhS6K specimens not subjected to preliminary heating, and that the coatings increase the fatigue strength of the alloy when subjected to preliminary soaking at 950 degrees C for 1,000 hours. It is shown that the types of coatings investigated provide an increase in the fatigue strength of specimens after preliminary soaking at high temperature over unprotected specimens. Author

N72-24611# Aeronautical Research Inst. of Sweden, Stockholm. **SILICONE RUBBER MOULDING AT LOW TEMPERATURES** Goeran Lundstroem 1972 5 p (Memo-82) Avail: NTIS HC \$3.00

Transparent replicas of ice structures and coatings were made with molding compounds of epoxy and silicone rubbers. Parts of an ice covered airplane wing were molded at the scene of an air crash and later reproduced. This provides a means of testing the actual wing profile in a wind tunnel. K.P.D.

N72-24613# Gillette Research Inst., Inc., Rockville, Md. **STUDIES OF SOIL/AIRCRAFT SURFACE/CLEANER INTERACTIONS TO PROVIDE A BASIS FOR IMPROVED CLEANER TESTING** Final Report, 13 Jan. 1971 - 12 Jan. 1972

Roy H. Kissinger and Charles A. Rader 20 Jan. 1972 30 p refs (Contract N00019-71-C-0228) (AD-736971) Avail: NTIS CSCL 11/11

The tasks of the program have been to establish the surface characteristics of aircraft painted with polyurethane paint conforming to Military Specification MIL-C-81773, to relate these surface characteristics to soil retention, to provide a well-characterized model soil, and to establish the necessary parameters for developing a laboratory test for cleaner formulations. Author (GRA)

N72-24616# Hughes Aircraft Co., Culver City, Calif. **DEVELOPMENT OF COMPOSITE CONSTRUCTIONS WITH IMPROVED RAIN EROSION RESISTANCE** Final Summary Report, 1 Apr. 1970 - 1 Nov. 1971

Boyce G. Kimmel Dec. 1971 72 p ref (Contracts N00019-71-C-0167)

(AD-738079; HAC-P71-443) Avail: NTIS CSCL 11/9

The report describes the continued investigation of end-oriented, fiber-reinforced plastic composites as rain erosion resistant materials. The studies included the effect on rain erosion resistance as determined by whirling arm tests of such variables as matrix, reinforcement, reinforcement configuration, composition, impact angle and fiber angle with respect to the specimen surface. Matrices evaluated included rigid epoxies, flexibilized epoxies, polyurethanes, polyphenylene oxide, polybutadiene, and polyimide. Reinforcements included ECG glass roving, SCG glass roving, Nomex 1200 denier yarn and Dacron 1100 denier yarn. Author (GRA)

N72-24618# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.

STRUCTURE-PROPERTY STUDY OF RAIN EROSION RESISTANT POLYURETHANE COATINGS Final Report, 23 Oct. 1970 - 22 Oct. 1971

Maurice A. Raymond 15 Dec. 1971 80 p refs (Contract N00019-71-C-0092)

(AD-737624) Avail: NTIS CSCL 11/3

A study was conducted on urethane elastomers in an attempt to define how chemical and structural features of the elastomer contribute to good rain erosion properties for aircraft radome coatings. In the first part of the program five correlations were developed between easily measured physical properties and rain erosion resistance as determined on a whirling arm rig. In the second part of the program thirty-three urethane elastomers were prepared in an experiment designed to study six chemical and structural properties. Author (GRA)

N72-24625# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

PROCEDURE FOR ESTIMATING STABILITY AND CONTROL PARAMETERS FROM FLIGHT TEST DATA BY USING MAXIMUM LIKELIHOOD METHODS EMPLOYING A REAL-TIME DIGITAL SYSTEM

Randall D. Grove, Roland L. Bowles, and Stanley C. Mayhew (Electronic Associates, Inc.) Washington May 1972 57 p refs (NASA-TN-D-6735; L-8178) Avail: NTIS HC \$3.00 CSCL 12A

A maximum likelihood parameter estimation procedure and program were developed for the extraction of the stability and control derivatives of aircraft from flight test data. Nonlinear six-degree-of-freedom equations describing aircraft dynamics were used to derive sensitivity equations for quasilinearization. The maximum likelihood function with quasilinearization was used to derive the parameter change equations, the covariance matrices for the parameters and measurement noise, and the performance index function. The maximum likelihood estimator was mechanized into an iterative estimation procedure utilizing a real time digital computer and graphic display system. This program was developed for 8 measured state variables and 40 parameters. Test cases were conducted with simulated data for validation of the estimation procedure and program. The program was applied to a V/STOL tilt wing aircraft, a military fighter airplane, and a light single engine airplane. The particular nonlinear equations of motion, derivation of the sensitivity equations, addition of accelerations into the algorithm, operational features of the real time digital system, and test cases are described. Author

N72-24649# Department of Trade and Industry, Stevenage (England).

AIR POLLUTION AT HEATHROW AIRPORT, LONDON: APRIL - SEPTEMBER, 1970

J. Parker 8 Feb. 1971 43 p refs Avail: NTIS HC \$4.25

Air pollution at Heathrow Airport, London, was measured at points where urban road traffic pollution could be separated from the runway and central airport pollution for comparison of traffic

and aircraft emissions. Information on maximum concentrations of pollution from aircraft on the takeoff run was gathered by measuring smoke, hydrocarbons, and oxides near the runway. The results indicate that the highest values for emissions come from road traffic and taxiing. F.O.S.

N72-24672*# Scripps Institution of Oceanography, San Diego, Calif.

VISUAL ASPECTS OF AIR COLLISION AVOIDANCE: COMPUTER STUDIES ON PILOT WARNING INDICATOR SPECIFICATIONS Final Report

Gerald D. Edwards and James L. Harris, Sr. Feb. 1972 28 p refs
(Grant NGR-05-009-059)
(NASA-CR-126669; SIO-Ref-72-3) Avail: NTIS HC \$3.50 CSCL 17G

Techniques of computer calculations used to analyze the potential for improving visual acquisition of collision threats by means of Pilot Warning Indicator systems (PWI) are described. The quantitative effects of PWI resolution and effective range upon the average cumulative probability of detection are presented. Author

N72-24673# National Aviation Facilities Experimental Center, Atlantic City, N.J.

EXPERIMENTATION SUPPORT FOR DEMONSTRATION OF AN AUTOMATIC POSITION REPORTING TECHNIQUE AT OAKLAND, CALIFORNIA Final Report, Jan. 1970 - Jul. 1971

Gerald E. Titherington, Michael J. Massimino, and James S. Beatty Apr. 1972 68 p
(FAA-RD-71-92; FAA-NA-72-28) Avail: NTIS HC \$5.50

The development of an automatic air traffic control system in which inertial navigation data position reports from commercial aircraft are combined with computer presentations is discussed. The position reports are received by VHF troposcatter antennas and relayed to a ground station. The reports are used as input to a computer-driven graphic display. The system displays the progress of the flight and makes it possible to extrapolate flight paths in the absence of data from the aircraft. Author

N72-24682# Control Data Corp., Bethesda, Md. Washington Systems Div.

THE EFFECTIVENESS OF THE SEE-AND-AVOID DOCTRINE: SAFE VERTICAL CLEARANCE FROM CLOUDS Final Report

V. Mangulis and W. Graham Dec. 1971 61 p refs
(Contract DOT-FA70WA-2263)
(AD-737804; FAA-RD-71-115) Avail: NTIS CSCL 01/2

The collision hazards of allowing VFR aircraft to fly in the proximity of clouds are evaluated and compared with the number of near-misses or collisions expected on a clear day due to human failure to see and avoid other aircraft. Some numerical results are presented for representative air traffic. Author (GRA)

N72-24683# Little (Arthur D.), Inc., Cambridge, Mass.
FACTORS INFLUENCING CAPACITY AND EFFICIENCY IN AIR TRAFFIC CONTROL Interim Report, Nov. 1970 - Oct. 1971

G. Raisbeck Nov. 1971 90 p refs
(Contract DOT-FA70WA-2141)

(AD-737513; FAA-RD-71-107) Avail: NTIS CSCL 17/7

Most of the report is devoted to a systematic catalogue of measurable quantities which can be related to capacity and efficiency. Each item is described to show how it affects capacity and efficiency and how it interacts with the other factors. Certain current research and development activities and the interests of some user groups have been related to the various categories of factors. Those particular groups of factors which stand out are discussed because of their absolute importance and because of the number of ways in which they interrelate to one another and to other factors. It is concluded that such a catalogue can be used to strengthen support for

research and exploratory development; shaping demand must be treated jointly with increasing capacity rather than as though it were independent; and a number of specific programs of observation and experiment can be inferred, the execution of which would give additional information about the effects on capacity which many of these factors might have. Author (GRA)

N72-24711*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CORRELATION OF TOTAL SOUND POWER AND PEAK SIDELINE OASPL FROM JET EXHAUSTS

Uwe H. vonGlahn [1972] 10 p refs Presented at 5th Fluid and Plasma Dyn. Meeting, Boston, 26-28 Jun., 1972; Sponsored by Am. Inst. of Aeron. and Astronaut.
(NASA-TM-X-68059; E-6921) Avail: NTIS HC \$3.00 CSCL 20A

An empirical analysis of jet noise is made for convergent exhaust nozzles. An engineering approach to the correlation of total sound power and maximum sideline overall sound pressure level (OASPL), at 200 ft, is presented for both subsonic and supersonic jets based on available data. Data correlation for subsonic jets shows no dependency of total sound power and maximum sideline OASPL on jet density. The analysis for supersonic jets results in a correlation parameter for jet total sound power consisting of the conventional Lighthill parameter modified by considerations of jet Mach number and jet acoustic velocity. Similar parameters also correlate the maximum sideline OASPL for supersonic jets. Author

N72-24806# Southwest Research Inst., San Antonio, Tex.
RESEARCH ON HYDROCARBON FUELS AND RELATED APPLICATIONS Technical Report, 1 Dec. 1970 - 30 Nov. 1971

Robert K. Johnson, Charles M. Monita et al Wright-Patterson AFB, Ohio AFAPL Jan. 1972 82 p refs
(Contract F33615-69-C-1231; AF Proj. 3048; AF Proj. 3066)
(AD-737833; SWRI-RS-581; AFAPL-TR-70-5-Pt-3) Avail: NTIS CSCL 21/4

Studies of the effects of various materials on jet fuel stability were made. Studies of equipment and procedure for rating fuel stability dealt primarily with the JFTOT fuel coker and with methods of polishing heater tubes for use in other fuel cokers. Fuel lubricity was investigated by means of a simulator measuring the starting friction of a valve spool; major sources of error have been identified and recommendations made for a minimum redesign. Fuel corrosion inhibitors were evaluated. Short-term studies have been made of analytical methods for fuel system icing inhibitor and oxygen content of fuels, along with investigation of fuel dyes, fuel compatibility of plastics, fuel acid number determinations, and calibration of the water separator (WSIM) apparatus. Operation of an existing information retrieval system has been continued, and jet fuel property data from world-wide procurement processed and analyzed. GRA

N72-24807 Ohio State Univ., Columbus.

MECHANISM OF MIXING OF TWO NONREACTING GASES Ph.D. Thesis

Paul James Ortwerth 1971 158 p
Avail: Univ. Microfilms Order No. 71-22518

The turbulence phenomena associated with the mixing of fuel and air in a supersonic combustion ramjet were studied. The turbulence generated by coaxial and normal jet fuel injection was studied by analyzing a control volume in which fuel and air are mixed. These two modes of fuel injection were examined for various initial conditions in order to compare their respective characteristics and determine the design advantages of each mode. The results of this analysis show that large turbulence energies can be generated, much larger than the energy added by the jet. A universal plot for a diatomic gas $\gamma = 1.4$ was determined for which specific impulse losses are found to be a function of relative turbulence intensity and flight speed. Experimental results from a compressible turbulent shear flow experiment, the decay of a supersonic free jet were used in

formulating a new theoretical model for turbulent shear flow. A fuel injector designed to maximize the turbulent kinetic energy was tested to verify the existing mixing rate correlations.

Dissert. Abstr.

N72-24813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY PERFORMANCE OF A LOW LOADING HIGH TIP SPEED FAN STAGE

Everett E. Bailey Mar. 1972 11 p ref
 (NASA-TM-X-68027; E-6826) Avail: NTIS HC \$3.00 CSCL 21E

Limited data indicates the feasibility of designing fan stages for operation with weak oblique shocks in the rotor blade tip region. A 1600 ft/sec rotor tip speed fan indicated an overall efficiency of 0.846 at a pressure ratio of 1.51 even though the rotor blades had incurred damage in the leading edge tip region prior to obtaining the design speed performance. After the test it was observed that a number of the rotor blade mid-span dampers had failed, subsequently damaging a number of rotor blades in the leading edge tip region. Author

N72-24815# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF FAILURE OF GAS TURBINE VANES UNDER INFLUENCE OF THERMAL CYCLES

G. N. Tretyachenko *In its* Gas Turbine Vanes 8 May 1972 p 1-13 refs

Avail: NTIS HC \$3.25

The basic principles of failure for gas turbine engines were studied by investigating short-term thermal cycles in turbine vane models. The effect was studied of mechanical loads including vibration and tensile loads that develop during rotor rotation due to centrifugal forces on thermal cracking. It is concluded that vane failure is governed by: (1) chemical reaction of surface layers with fuel combustion products; (2) accumulation of cyclic deformations at the edges due to thermal stresses occurring during heating and cooling; and (3) cyclic stresses due to vibration. F.O.S.

N72-24822# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.

A CERAMIC THERMAL BARRIER FOR HIGH TEMPERATURE ENGINE COMPONENTS

R. L. Newman, K. R. Cross, W. C. Spicer, H. D. Sheets (Battelle Mem. Inst., St. Louis, Mo.), and T. D. Driskell (Battelle Mem. Inst., St. Louis, Mo.) Sep. 1971 66 p refs Backup document for AIAA Synoptic, "Application of Thermal Barriers to High Temperature Engine Components", scheduled for publication in Journal of Aircraft in Sep. 1972

(Rept-21-C-71F) Avail: NTIS HC \$5.50

Cooling systems for controlling the structural temperatures of turbine engines are discussed. The thermal barrier, a low conductivity coating, is a means of reducing the cooling requirements. The chief benefit of the thermal barrier will be in saving the cooling air. The relative merits of a thin, monolithic structure and a thick reinforced structure are examined. A test program to match or exceed engine conditions with selected ceramic systems is included. The materials tested were alumina (high shock resistance), zirconia (low thermal conductivity), and zircon foam (very low conductivity). Author

N72-24824# Joint Publications Research Service, Arlington, Va.
STATISTICAL EVALUATION OF CHARACTERISTICS OF HEAT-RESISTANT MATERIALS FOR GAS TURBINE ENGINES

I. P. Bulygin, N. I. Parfenova, L. N. Timofeyeva, and I. I. Trunin 16 May 1972 10 p refs Transl. into ENGLISH from Probl. Prochnosti (Moscow), no. 10, 1970 p 20-24

(JPRS-56002) Avail: NTIS HC \$3.00

The changes in long-term tensile strength and creep as a function of test temperature and test time were investigated in EP109VD nickel alloy and EI961 steel for gas turbine engine applications. The results were analyzed statistically, and it was determined that the dispersion of the characteristics can serve as

a criterion for time and temperature limits of reliable working capacity. N.E.N.

N72-24825# Joint Publications Research Service, Arlington, Va.
INCREASE IN RELIABILITY OF GAS TURBINE ENGINES

15 May 1972 23 p refs Transl. into ENGLISH from Problemy Prochnosti, No. 7, 1971

(JPRS-55987) Avail: NTIS HC \$3.25

Investigations on the mechanical properties of vanes and disks of gas turbine engines are reported.

N72-24826# Joint Publications Research Service, Arlington, Va.
FATIGUE STRENGTH OF MODELS OF GAS TURBINE VANES DURING PROGRAMMED TEMPERATURE CHANGE APPROXIMATING THE OPTIONAL CHANGE

B. N. Sinayskiy *In its* Increase in Reliability of Gas Turbine Engines 15 May 1972 p 62-68 refs

Avail: NTIS HC \$3.25

The fatigue strength and durability of vane models were investigated under isothermal conditions and with programmed temperature changes, simulating the thermal conditions of working turbine vanes. For reproducing static tensile stresses produced by centrifugal forces during fatigue tests, the vane model was made in the form of a double closed model of a working turbine vane, fabricated from cast refractory nickel-based ZhS6K alloy. Smooth cylindrical specimens of the same alloy, 9 mm in diameter, were tested to obtain comparative characteristics of fatigue strength and durability. Author

N72-24827# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF THE CONDITION OF TURBINE DISC MATERIAL AFTER OPERATION

I. A. Kozlov, V. N. Rudenko, and G. V. Rybenok *In its* Increase in Reliability of Gas Turbine Engines 15 May 1972 p 78-82 refs

Avail: NTIS HC \$3.25

The mechanical properties of short smooth specimens of turbine disks were determined. Turbine disks with 0, 143, 2221, and 2934 hours of operation were cut on anode-mechanical machines. The specimens were kept in the elastic region during the tests. Impact toughness, creep, and short-term and long-term tensile strength tests were performed. It is felt that the results indicate high performance characteristics of the alloys with low damage under conditions of long-term loads and high temperatures. N.E.N.

N72-24828*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

LF467 CONCEPT DEFINITION

Jan. 1972 121 p refs

(Contract NAS3-15690)

(NASA-CR-120909; R72-AEG-207) Avail: NTIS HC \$8.25 CSCL 21A

The LF467 concept is discussed. The LF467 is an advanced turboprop lift fan intended for application with the YJ97-GE-100 turbojet gas generator on a V/STOL transport research aircraft. The program objective was to define a fan that develops a reasonably high (1.30) fan pressure ratio consistent with propulsion requirements of a V/STOL research transport aircraft and that exhibits the ability to achieve a 100 PNdE overall noise objective through the use of modest additional installation treatment. The aerodynamic and mechanical designs of this system and the resulting configuration, weight, and noise predictions are presented. Author

N72-24829*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DRIVE TURBINE SYSTEMS FOR 20-INCH TURBOFAN

SIMULATORS. 1: DUCT TURBINE DESIGN

Warren J. Whitney May 1972 18 p refs
(NASA-TM-X-68081; E-6972) Avail: NTIS HC \$3.00 CSCL 21E

A study was made to evolve the turbine drive systems for 20-inch turbofan engine simulators. The fan designs used in the simulators included single-stage and two-stage configurations that covered a wide range of rotative speed and power requirement. The objective assumed for the study was to evolve one core turbine design that could drive all of the single-stage fans and, when operated in combination with one duct turbine design, drive all of the two-stage fans. The duct turbine power output is then needed to determine the make-up power required of the core turbine over the range of two-stage fan operating conditions. The duct turbine design analysis is reported and includes the selection of the duct turbine velocity diagram, a description of the blade design, and a determination of its off-design performance. Adjustable stators were found to be quite advantageous to the duct turbine off-design operation. The use of adjustable stators enabled the duct turbine to accommodate fan mass flow at all operating points and caused the duct turbine power output to increase as the total power requirement increased. This in turn resulted in a core turbine make-up power requirement that was not significantly greater than that required for driving the single-stage fans. Author

N72-24830* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REVIEW OF JET ENGINE EMISSIONS

Jack Grobman 1972 17 p refs Presented at the DOT Surv. Conf., Climatic Impact Assessment Program, Cambridge, Mass., 15-16 Feb. 1972
(NASA-TM-X-68064; E-6938) Avail: NTIS HC \$3.00 CSCL 21E

A review of the emission characteristics of jet engines is presented. The sources and concentrations of the various constituents in the engine exhaust and the influence of engine operating conditions on emissions are discussed. Cruise emissions to be expected from supersonic engines are compared with emissions from subsonic engines. The basic operating principles of the gas turbine combustor are reviewed together with the effects of combustor operating conditions on emissions. The performance criteria that determine the design of gas turbine combustors are discussed. Combustor design techniques are considered that may be used to reduce emissions. Author

N72-24934# Advisory Group for Aerospace Research and Development, Paris (France).

NONDESTRUCTIVE TESTING AND INSPECTION APPLIED TO COMPOSITE MATERIALS AND STRUCTURES

Feb. 1972 34 p refs Presented at 32d AGARD Structures and Mater. Panel Meeting, London, 31 Mar. 1971
(AGARD-R-590) Avail: NTIS HC \$3.75

Papers on nondestructive testing applied to specimens and structural parts made of composite materials are presented. Various methods for failure inspection in carbon fiber composites and the possibilities and limitations of nondestructive inspection for quality control of airframes made of boron composites are discussed.

N72-24936# Air Force Materials Lab., Wright-Patterson AFB, Ohio. Advanced Composites Div.

NONDESTRUCTIVE INSPECTION PRACTICES USED IN PRODUCTION OF COMPOSITE AIRFRAME STRUCTURES

E. H. Jaffe In: AGARD Nondestructive Testing and Inspection Applied to Composite Mater. and Structures Feb. 1972 p 23-31
Avail: NTIS HC \$3.75

The possibilities and limitations of nondestructive inspection (NDI) applied to the quality control of a primary structural part made of boron composite are described. The NDI is discussed using typical first generation high modulus composite aircraft empennage structures as examples of current practices in airframe production. The following subjects are discussed: (1) the most frequently occurring defects in manufacture of composite

structures; (2) major NDI techniques currently available, and their limitations; (3) some newer techniques, and how they will fill the gap; and (4) problems of acceptance/rejection criteria, and how these decisions may be quantified. Author

N72-24979# Civil Aeronautics Board, Washington, D.C.

HANDBOOK OF AIRLINE STATISTICS: DATA FOR INDIVIDUAL CARRIERS, 1962-1970, DATA FOR CARRIER GROUPS, 1926-1970

Jan. 1972 597 p

Avail: SOD \$10.50

Statistical data are presented in tabular form for individual air carriers for the years 1962 to 1970. Carrier group data are given for 1926 through 1970. K.P.D.

N72-24981# Civil Aeronautics Board, Washington, D.C. Bureau of Operating Rights Standards Div.

COMMUTER AIR CARRIER TRAFFIC STATISTICS, YEAR ENDING 20 JUNE 1971

Jan. 1972 22 p

Avail: NTIS HC \$3.25

Passenger, cargo, and mail statistics for commuter air carriers are presented. Compared to FY 1970 data, the number of flights decreased over 13%, the number of passengers increased 3.2%, the cargo volume increased 23%, and mail increased 18.2%. N.E.N.

N72-24982# Resource Management Corp., Inc., Bethesda, Md. AVIATION COST ALLOCATION STUDY: FAA AIRPORT AND AIRWAY SYSTEM COST ELEMENTS

Feb. 1972 124 p Sponsored by FAA

Avail: NTIS HC \$8.25

A compendium of planning factors for estimating the investment and operating costs of all elements of the FAA Airport and Airway System is presented. Unit cost data are presented for all facilities and equipments now in operation or currently being developed. While primarily developed for supporting the study of cost allocation and the user taxes of the FAA system, it was felt that the unit cost estimates would be of use to both Department of Transportation and Federal Aviation Administration officials in related policy issues as well as other interested parties. The discussion of the FAA system is separated into six functional categories: airport systems, terminal control systems, en route control systems, flight service systems, support systems, and research and development programs. Author

N72-24985# Bechtel Corp., San Francisco, Calif.

ECONOMIC STUDIES: CAPITAL COST ANALYSIS OF AIRPORT ALTERNATIVES

Oct. 1971 160 p ref Sponsored in parts by FAA and HUD

Avail: NTIS HC \$10.00

A series of airport alternative for the San Francisco Bay area was reviewed for cost and then considered on a present value basis to allow further assessments when weighed against anticipated income and other benefits. Cost data were accumulated on current and projected bases, and order-of-magnitude cost estimates were made for 37 alternative airport expansion projects at 20 airports. The expansion of general aviation airports was estimated by using existing master plans which included adding a second runway or extending an existing one, and adding taxiways, tie-down areas, aprons, or a tower. Rapid transit connections were included in commercial airport projects. The projects varied in cost because of expensive fill and diking requirements. The major components of the project are land, building construction, and heavy construction. These are considered, along with the effects of their different rates of escalation. N.E.N.

N72-24986# Flughafen, Frankfurt am Main (West Germany). Planungsabteilung.

PROBLEMS OF THE LOCATION OF AIRPORTS IN THE FEDERAL REPUBLIC OF GERMANY [DIE GEOGRAPHISCHE PROBLEMATIK DER LAGE VON FLUGPLATZEN IN DER BRD]

Peter-Michael Gerhardt Cologne DGLR 1971 18 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971 (DGLR-Paper-71-075) Avail: NTIS HC \$3.00

The optimum locations for airports and landing strips and their distance to city centers are discussed. Locations are analyzed in terms of transport facilities for passengers, accompanying parties, visitors, and airport personnel to and from airports, including railways, highways, and roads. Airports are considered as pollution centers, and noise and air pollution in the vicinity of airports are discussed. The future development of airports in Western Germany is considered. Author (ESRO)

N72-24989 West Virginia Univ., Morgantown.

ANALYSIS OF A CIRCULATION CONTROLLED ELLIPTICAL AIRFOIL Ph.D. Thesis

Jack Peter Ambrosiani 1971 184 p
Avail: Univ. Microfilms Order No. 71-26650

A theoretical analysis on a 20% thickness/chord ellipse with circulation control by tangential trailing edge blowing is considered. The analysis yields the sectional lift and drag coefficients for given ambient conditions, flight conditions, and prescribed blowing reservoir conditions. The method of solution is an iterative one, and involves the matching of an assumed sectional lift coefficient with the sectional lift coefficient calculated from the actual pressure distribution over the body in the presence of trailing edge blowing. In order to obtain the pressure on the wall in the wall jet region a full-boundary layer analysis is required over the airfoil. The Karman-Pohlhausen integral method is used in the laminar region and the Nash and Hicks turbulent layer analysis is used in the turbulent region. This analysis confirms the feasibility of obtaining high lift coefficients with relatively low blowing rates. Dissert. Abstr.

N72-24990*# Techtran Corp., Glen Burnie, Md.

A VORTEX MODEL DEALING WITH THE AIRSTREAM AT THE ROTOR BLADE OF A HELICOPTER

W. H. Isay Washington NASA Apr. 1972 55 p refs Transl. into ENGLISH from "Ein Wirbelmodell zur Behandlung der Stroemung am Rotorblatt eines Hubschraubers", Inst. for Shipbuilding of the Univ. of Hamburg, report No. 272, Jul. 1971 (Contract NASw-2037) (NASA-TT-F-14228; Rept-272) Avail: NTIS HC \$4.75 CSCL 01A

With the aid of the nonstationary vortex line-support theory an approximate method is given for calculating the buoyancy distribution at rotor blades in forward flight. The theory presented takes into consideration, with reference to vortex geometry, a nonuniform (especially trapezoidal) flow through the plane of the rotor, as well as the unrolling process and the contraction of the free transverse vortex. In the determination of the circulation distribution of the rotor airflow, a special case is treated where the blades penetrate the unrolled and contracted tip vortex and root vortex of the sometimes forward-driving airfoils. Formulas for computing acoustic pressure fields radiated from a rotor (compressible treatment) are included. Author

N72-24991*# North Carolina State Univ., Raleigh.

FLIGHT TESTING TECHNIQUES FOR THE EVALUATION OF LIGHT AIRCRAFT STABILITY DERIVATIVES: A REVIEW AND ANALYSIS

Frederick O. Smetana, Delbert C. Summey, and W. Donald Johnson Washington NASA May 1972 113 p refs (Contract NAS1-9603)

(NASA-CR-2016) Avail: NTIS HC \$3.00 CSCL 01A

Techniques quoted in the literature for the extraction of stability derivative information from flight test records are reviewed. A recent technique developed at NASA's Langley

Research Center was regarded as the most productive yet developed. Results of tests of the sensitivity of this procedure to various types of data noise and to the accuracy of the estimated values of the derivatives are reported. Computer programs for providing these initial estimates are given. The literature review also includes a discussion of flight test measuring techniques, instrumentation, and piloting techniques. Author

N72-24992*# Boeing Co., Renton, Wash.

PREDICTION OF UNSTEADY AERODYNAMIC LOADINGS CAUSED BY TRAILING EDGE CONTROL SURFACE MOTIONS IN SUBSONIC COMPRESSIBLE FLOW: ANALYSIS AND RESULTS

W. S. Rowe, B. A. Winther, and M. C. Redman Washington NASA Jun. 1972 77 p refs (Contract NAS1-10536)

(NASA-CR-2003) Avail: NTIS HC \$3.00 CSCL 01A

A theoretical analysis and a computer program have been developed for the prediction of unsteady lifting surface loadings caused by motions of trailing edge control surfaces having sealed gaps. The final form of the downwash integral equation has been formulated by isolating the singularities from the non-singular terms and establishing a preferred solution process to remove and evaluate the downwash discontinuities in a systematic manner. Comparisons of theoretical and experimental pressure data are made for several control surface configurations. The comparisons indicate that reasonably accurate theoretical pressure distributions and generalized forces may be obtained for a wide variety of control surface configurations. Spanwise symmetry or antisymmetry of motion, and up to four control surfaces on each half span can be accommodated. Author

N72-24993*# Scientific Translation Service, Santa Barbara, Calif.

EVALUATION OF FLIGHT MEASUREMENTS AND PLOTTING OF LOAD COLLECTIVES

H. Strehlow and N. Mihalcea Washington NASA May 1972 32 p refs Transl. into ENGLISH from Proc. of DGLR Symp. on Helicopters and Propellers, Immenstaad, West Germany, 24 Jun. 1969, report DLR-MITT-70-01, Dec. 1970 p 124-156 (Contract NASw-2035)

(NASA-TT-F-14283; DLR-MITT-70-01) Avail: NTIS HC \$3.75 CSCL 01A

The practical application of computers to the development and flight testing of helicopters is discussed. By classifying the dynamic stresses and establishing the spectral power density of measured vibration curves, load collective and damage criteria are established. Potential applications in the solution of various serviceability problems are described. The evaluation methods used and the necessary employment of electronic data processing equipment are explained. Author

N72-24996# Aeronautical Research Labs., Melbourne (Australia).

A DYNAMICAL THEORY OF FLUTTER

A. E. Billington May 1971 14 p refs (ARL/SM-332) Avail: NTIS HC \$3.00

It is argued that no truly dynamical theory of flutter has been propounded. Ideas are limited to the elementary case of translation and rotation of a rigid wing. The motion of the wing and the motion of the air are incorporated in the one dynamical system. When the linear and angular deviations of the wing about a straight line fixed in space are small and when its motion is uniform in the absence of such deviations, the position of the wing is at any time determined by the solution functions of two simultaneous second order linear differential equations. These equations have constant coefficients when the motion is referred to moving axes fixed in the wing. The inclusion of a circulation term renders the equations nonhomogeneous by reason of its independence of motion and configuration. This term is reinterpreted as a periodic forcing function of the finite dynamical system represented by the equations. The amplitude and phase of the forcing function are synchronized with the circulation of an initial fluid motion--one intended to correspond to the onset of a flutter instability--in which the magnitude of the circulation is fixed by the Joukowski condition and in which the

time rate of variation of the circulation is zero. These two conditions coupled with those of initially zero displacement variables constitute the four initial conditions to be satisfied by the solution of the pair of differential equations. Author

N72-24998# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A REVIEW OF SOME PUBLISHED DATA ON THE EXTERNAL-FLOW JET-AUGMENTED FLAP

D. H. Perry London ARC 1972 60 p refs Supersedes RAE-TR-70240; ARC-32714 (ARC-CP-1194; RAE-TR-70240; ARC-32714) Avail: NTIS HC \$5.00; HMSO 90p; PHI \$3.65

The data given in 13 NASA papers describing wind tunnel tests on external flow jet augmented flaps are reviewed. Details are given of the configurations tested and the main results achieved. Some of the data is compared with theoretical work done in the UK in support of internally ducted jet flap schemes. The application of jet flap theory to the correlation of maximum lift coefficients, based on considerations of leading edge loading, is given. Author (ESRO)

N72-24999# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

AN INVESTIGATION OF ANNULAR AEROFOILS FOR TURBOFAN ENGINE COWLS

C. Young London ARC 1972 91 p refs Supersedes RAE-TR-69285; ARC-32241 (ARC-R/M-3688) Avail: NTIS HC \$6.75; HMSO £3.27; PHI \$12.95

The annular aerofoils suitable for use as short fan cowls on turbofan engines of high bypass ratio have been tested at zero incidence over a range of subsonic Mach numbers and also in static conditions. Comparisons are presented with experimental results from a conventional type of pipe rig, and with predictions from a linearized and a nonlinearized theory. The results show that the effect of the cowl afterbody is fairly small and can be calculated theoretically. Both types of theoretical methods give good predictions of the surface pressure distribution, but the comparison between theoretical and measured mass flow through the cowl deteriorates as Mach number increases. Author (ESRO)

N72-25000# Cambridge Univ. (England). Dept. of Engineering. **THE UNSTEADY RESPONSE OF AN AXIAL FLOW COMPRESSOR WITH A DISTORTED INLET FLOW**

H. Mokelke London Aeron. Res. Council 1972 46 p refs Supersedes ARC-32372 (ARC-CP-1203; ARC-32372) Avail: NTIS HC \$4.50; HMSO 75 p; PHI \$3.15

The response of a 4-stage axial flow compressor with a hub/tip ratio of 0.8 is investigated with a 60 deg square wave inlet distortion and with a triangular spoiler configuration inlet distortion. By measuring the total pressures, static pressures, and yaw angles behind each stage, the development of the distortion is followed through the compressor. ESRO

N72-25001 Washington Univ., St. Louis, Mo. **THE METHOD OF MULTIBLADE COORDINATES IN THE LINEAR ANALYSIS OF LIFTING ROTOR STABILITY AND GUST RESPONSE** Ph.D. Thesis

Sheng-Kuang Yin 1971 202 p
Avail: Univ. Microfilms Order No. 71-27371

The dynamic linearized or perturbation problem of a lifting rotor with rigid flapping blades having elastic restraints, with rigid hub and with four types of control feedback is solved for low and high rotor advance ratios with the method of multiblade generalized coordinates, using the Floquet state transition matrix. While previous applications of multiblade coordinates were limited to the use of the first cyclic flapping or in-plane modes and to constant coefficient rotor representations, the present

study extends this work to include coning, differential coning and warping rotor modes and considers the periodicity of the coefficients in the dynamic rotor equations. The conventional modal columns now become time functions. Numerical examples assuming several blades per rotor show considerable differences in the modal function columns and in the gain factors at the stability limits depending on the number of blades.

Dissert. Abstr.

N72-25002 Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).

STATISTICAL ANALYSIS OF MISSION-PROFILE PARAMETERS OF TRANSPORT AIRPLANES [STATISTISCHE AUSWERTUNG VON PARAMETERN FUR EINSATZ-PROFILI VON TRANSPORTFLUGZEUGEN]

O. Buxbaum and P. Reinhold 1971 41 p refs In GERMAN (TB-88; CAF-Doc-582) Copyright. Avail: Issuing Activity

The cumulative frequency distributions of the following mission profile parameters of different types of transport airplanes are shown: flight time, airplane take-off weight, airplane landing weight, and fuel weights during take-off and landing. Examples of jet powered short-, medium-, and long-range passenger and cargo airplanes are used to demonstrate that the obtained results can be used for the design of other similar airplanes.

Author

N72-25003# National Transportation Safety Board, Washington, D.C.

AN ANALYSIS OF AIRCRAFT ACCIDENT DATA: US GENERAL AVIATION 1969

29 Mar. 1971 22 p
Avail: NTIS HC \$3.25

An analysis of the aircraft accidents occurring within the category of U.S. general aviation for calendar year 1969 is presented. The subjects discussed are: (1) growth of general aviation, (2) accident data, (3) accident analysis by type of flying, (4) accident analysis by accident type, (5) collisions between aircraft, and (6) accident analysis by cause and related factor.

Author

N72-25004# National Transportation Safety Board, Washington, D.C.

ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA: US GENERAL AVIATION, CALENDAR YEAR 1969

28 Apr. 1971 155 p
(NTSB-ARG-71-1) Avail: NTIS HC \$9.75

The Annual Review of Aircraft Accident Data is a statistical compilation published by the National Transportation Safety Board. The publication contains statistical information compiled from reports of 4,767 general aviation accidents that occurred during the calendar year 1969. Included in the total number of accidents are 45 collisions between aircraft. By coding each aircraft involved in the collisions, an additional 45 records are produced, bringing the total accidents records to 4,812. This figure reflects the true number of pilots and aircraft involved in the accidents. Author

N72-25005*# Hamilton Standard, Windsor Locks, Conn. **COMPUTER PROGRAM USER'S MANUAL FOR ADVANCED GENERAL AVIATION PROPELLER STUDY**

Rose Worobel Washington NASA May 1972 76 p refs (Contract NAS2-6477)

(NASA-CR-2066) Avail: NTIS HC \$3.00 CSCL 01B

A user's manual is presented for a computer program for predicting the performance (static, flight, and reverse), noise, weight and cost of propellers for advanced general aviation aircraft of the 1980 time period. Complete listings of this computer program with detailed instructions and samples of input and output are included. Author

N72-25006# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT, SOUTHERN AIRWAYS,

INCORPORATED, DC-9, N97S, TRI-STATE AIRPORT, HUNTINGTON, WEST VIRGINIA, 14 NOVEMBER 1970
14 Nov. 1970 80 p

(NTSB-AAR-72-11) Avail: NTIS HC \$6.00

A DC-9, N97S, operating as a charter flight, crashed during a landing attempt at the Tri-State Airport, Huntington, West Virginia, on November 14, 1970. All 75 occupants, including 71 passengers and four crewmembers, were fatally injured. The aircraft was destroyed. The flight was attempting a nonprecision instrument landing approach at the time of the accident. The crash occurred following impact with trees on a hill approximately 1 mile west of the runway threshold. The probable cause of this accident was the descent below minimum descent altitude during a nonprecision approach under adverse operating conditions, without visual contact with the runway environment. The Board has been unable to determine the reason for this descent although the two most likely explanations are (1) improper use of cockpit instrumentation data, or (2) an altimetry system error. Author

N72-25007# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Flight Test Engineering Div.

EC-130E RADOME COMPATIBILITY TEST

Richard Solem and Philip P. Panzarella Oct. 1971 37 p

(ENEA-71-45) Avail: NTIS HC \$4.00

The results of flight tests for determining the effects of installing an X band nose radome in an EC-130E aircraft are reported for takeoff, climb, and cruise. The changes in stability and control characteristics of the modified aircraft were also investigated. It was found that the redesigned nose section changed the airspeed error correction at takeoff by one knot, and by four knots for the landing configuration. The stall speed is also four knots higher than for the basic C-130E. The degradation in cruise performance was 10 to 11% and for climb performance was 15 to 16%. It is recommended that the air speed calibration data be used to update flight manuals, and that performance flight tests be conducted to determine the degradation within + or - 1%. F.O.S.

N72-25008# Xonics, Inc., Van Nuys, Calif.

VORTEX OBSERVATIONS BY THE XONICS ACOUSTIC RADAR AT NAFEC Final Report

Martin Balser, Arthur E. Nagy, and Andrew P. Proudian Dec. 1971 123 p

(Contract DOT-FA71WA-2672)

(FAA-RD-71-103; TR-7) Avail: NTIS HC \$8.25

A series of flight tests was conducted in order to demonstrate feasibility of the concept of the Xonics acoustic vortex detector. The first tests consisted of simultaneous observations in close proximity by both the Xonics equipment and the instrumented tower of vortices shed by a low-flying aircraft. Except for the few cases where data was lost through equipment misalignment or malfunction or operator error, vortex returns were observed on virtually all of the runs. A total of 55 runs, which represents a substantial fraction of all of the data gathered, were selected for analysis. The vortex velocity measurements exhibit a clear correlation with aircraft configuration, and appear to confirm their use as a valid indicator of vortex intensity. Author

N72-25009# Bristol Univ. (England).

A METHOD OF IMPROVING AIRCRAFT GROUND PERFORMANCE IN SLUSH AND WET CONDITIONS

R. V. Barrett London ARC 1972 25 p refs Supersedes ARC-33108

(ARC-CP-1206; ARC-33108) Avail: NTIS HC \$3.25; HMSO 45p; PHI \$1.95

A small wheel placed ahead of an aircraft main landing wheel can effectively clear a path for it through slush or standing water. In this investigation, model pneumatic wheels of 9 in and 3 in diameter were used to determine the effect of the forewheel on the drag and spray from the main wheel and on its aquaplaning characteristics. The model was run at speeds up to 115 ft per sec in a water depth of 0.25 in on a moving runway apparatus. Total wheel drag was reduced by the auxiliary wheel

except at very low speeds, the maximum reduction of nearly 50% occurring just below the normal aquaplaning speed of the main wheel. Aquaplaning of the main wheel only occurred after the auxiliary wheel had aquaplaned. This could be prevented by using a very high auxiliary wheel tyre pressure. The height of the intense region of the main spray plume was considerably reduced. Author (ESRO)

N72-25010# British Aircraft Corp., Preston (England). Flight Simulation Section.

A SIMULATOR STUDY OF DIRECT LIFT CONTROL

A. G. Barnes, D. E. Houghton, and C. Colclough London Aeron. Res. Council 1972 68 p refs

(ARC-CP-1199) Avail: NTIS HC \$5.50; HMSO £1; PHI \$3.90

A fixed base simulator study of direct lift control as applied to the VC-10 aircraft is described. The practical limitations imposed by factors such as the small spoiler authority to control lift, the power control dynamics, and the c.g. range over which the system must operate are included. A degree of improvement in longitudinal handling can be obtained from DLC, but it seems from this work that the most promising arrangement lies in a combination of DLC and a 'manoeuvre boost' input to the elevator. Confirmation by flight trials of the improved performance in the landing flare is needed, because of the difficulties of simulating this phase of flight. Author (ESRO)

N72-25011# Boeing Co., Renton, Wash. Commercial Airplane Group.

STUDY COVERING CALCULATIONS AND ANALYSIS OF SONIC BOOM DURING OPERATIONAL MANEUVERS. VOLUME 1: ANALYSIS AND COMPUTATION OF MANEUVER EFFECTS Final Report, Apr. 1970 - Feb. 1971

Feb. 1971 313 p refs

(Contract DOT-FA70WA-2315)

(AD-735296; D6A-12108-1-Vol-1; EQ-71-2) Avail: NTIS CSCL 01/2

The methods and results of the study of the effects of operational SST maneuvers on sonic boom are contained in three volumes. Volume I shows that the theoretical effects of operational maneuvers due to typical SST maneuvers are small except for maneuvers at Mach numbers below about Mach 1.3. Methods are outlined for applying the results to any airplane, and selected pressure signatures are presented for the U.S. SST and SCAT 15-F. Author (GRA)

N72-25012# California Inst. of Tech., Pasadena. Dept. of Applied Mathematics.

FINITE AMPLITUDE WAVES ON AIRCRAFT TRAILING VORTICES

D. W. Moore Oct. 1971 27 p refs

(Contract AF-AFOSR-1804-69; AF Proj. 9781)

(AD-737859; AFOSR-72-0033TR) Avail: NTIS CSCL 01/2

Numerical methods are used to study the growth of waves of finite amplitude on a pair of parallel infinite vortices. The vortices are treated as lines except where the detailed structure of the core is needed to remove consistently the singularity in the line integrals for the velocities of the vortices. It is shown that the vortices eventually touch and the shape of the wave at this instant is calculated. Wave distortion and gross properties are related to linear theory. GRA

N72-25013# National Transportation Safety Board, Washington, D.C.

AIRCRAFT INCIDENT REPORT: NORTHEAST AIRLINES, INCORPORATED, MCDONNELL DOUGLAS DC-9-31, N982NE, MARTHA'S VINEYARD, MASSACHUSETTS, 22 JUNE 1971

29 Dec. 1971 19 p

(PB-207101; NTSB-AAR-72-4) Avail: NTIS HC \$3.00 CSCL 01B

On June 22, 1971, a DC-9-31 struck the water during a

nonprecision instrument approach and received minor damage. There were no injuries to the three passengers and five crew members aboard the aircraft. The weather at the airport was reported to be: sky obscured; indefinite ceiling 300 feet; visibility 1 mile in fog; wind 030 at 5 knots; and the altimeter was 29.81 inches of mercury. The flight was performing a VOR straight-in approach to Runway 24 at Martha's Vineyard at the time of the incident. The aircraft struck the water approximately 3 miles short of the runway. Minor structural damage was incurred by the lower aft section of both engines. The National Transportation Safety Board determines that the probable cause of this incident was the lack of crew coordination in monitoring the altitude during the performance of a nonprecision instrument approach, the misreading of the altimeter by the captain, and lack of altitude awareness on the part of both pilots. Author (GRA)

N72-25014# European Research Office, London (England).
THE WG.13 LYNX HELICOPTER: SUMMARY OF LECTURES PRESENTED AT THE ROYAL AERONAUTICAL SOCIETY
 Richard L. Scharpf 2 Feb. 1972 19 p refs Conf. held at London, 13 Jan. 1972
 (AD-737611; ERO-1-1972) Avail: NTIS CSCL 01/3

The report covers the historical background through the development stage and discusses the achievement up to approximately December 1971. The new design features such as the rotor head, rotor blade, transmission and the Rolls Royce 360 engine are covered in more detail. The functions of the Automatic Flight Control System are also discussed. Flight test progress is also discussed. Author (GRA)

N72-25015# Boeing Co., Seattle, Wash. Aerospace Group.
COCKPIT GEOMETRY EVALUATION. VOLUME 1: PROGRAM DESCRIPTION AND SUMMARY Final Report, 1 Feb. - 31 Aug. 1970
 Patrick W. Ryan Nov. 1971 143 p refs
 (Contract N00014-68-C-0289; NR Proj. 213-065)
 (AD-738006; D162-10125-2A-Vol-1; JANAI-701213-Vol-1) Avail: NTIS CSCL 01/3

The Cockpit Geometry Evaluation Program is an experimental development to establish a standardized method for evaluating the physical geometry of a crew station. It evaluates the physical compatibility of a seated crew member of any size with any crew station beginning with the design concept. Data on the geometry of the crew station, the anthropometric characteristics of the crew members, and the sequence of tasks to be performed are stored in a computer. Mathematical routines provide dynamic movement for a variable-sized mathematical man-model. Numerical performance indicators, identification of physical and visual interferences, and reach infeasibilities are output. The crew station compliance with certain MIL-STD and -SPEC requirements is also checked. Volume 1 of the final report summarizes the results and techniques of Phases I, II and II-A. Author (GRA)

N72-25016# Boeing Co., Seattle, Wash. Aerospace Group.
COCKPIT GEOMETRY EVALUATION. VOLUME 3: COMPUTER PROGRAM Final Report, 1 Feb. - 31 Aug. 1970
 Robert Katz, Ann Rice, and Elsie I. Nakagawa Nov. 1971 796 p refs
 (Contract N00014-68-C-0289; NR Proj. 213-065)
 (AD-738007; D162-10127-2A-Vol-3; JANAI-701214-Vol-3) Avail: NTIS CSCL 01/3

The Cockpit Geometry Evaluation (CGE) Program is a development of improved methods for evaluating the physical compatibility of crew members with crew stations. The heart of the program is a 23-joint, three-dimensional man-model (BOEMAN) that simulates the motion of humans performing tasks in a given environment. The computer program system (CPS) ties the project together. The system uses an updatable bank of anthropological, environmental and task sequence data. The system provides information concerning data consistency, reach capability, crew station compliance to select military standards, locations and orientations of joints and body segments during movement, visual and/or physical interference of

BOEMAN with the crew stations and with himself, numerical performance data on joint displacement and deflection, and mass displacements. Author (GRA)

N72-25017# Boeing Co., Seattle, Wash. Aerospace Group.
COCKPIT GEOMETRY EVALUATION. VOLUME 4: MATHEMATICAL MODEL Final Report, 1 Feb. - 31 Aug. 1970
 Michael J. Healy Nov. 1971 110 p refs Revised
 (Contract N00014-68-C-0289; NR Proj. 213-065)
 (AD-738008; D162-10128-2A-Vol-4; JANAI-701215-Vol-4) Avail: NTIS CSCL 01/3

This volume describes the mathematical man-model of Phase II-A of the Cockpit Geometry Evaluation (CGE) Program and replaces the contents of the Phase II volume (D162-10128-2). The CGE Program is developing a computerized method to evaluate the physical compatibility of crew members with crew stations beginning with the conceptual phases of the design. A link system enclosed by geometrical shapes has been developed to date to model any specified sized member of a human population. The majority of the link connecting points represent major joint centers of the body and the geometric shapes, based on anthropometric data, represent body segments. Author (GRA)

N72-25018# Boeing Co., Seattle, Wash. Aerospace Group.
COCKPIT GEOMETRY EVALUATION. VOLUME 5: VALIDATION
 Patrick W. Ryan, Harland N. Sather, and Arthur W. Barse Nov. 1971 192 p refs Revised
 (Contract N00014-68-C-0289; NR Proj. 213-065)
 (AD-738009; D162-10129-2A-Vol-5; JANAI-701216) Avail: NTIS CSCL 01/3

The Cockpit Geometry Evaluation (CGE) Program is developing improved methods of evaluating the interaction and compatibility of crew members with crew stations. The main feature is a computer program system (CGECPS) containing a 23-joint, three-dimensional man-model (BOEMAN) which can mathematically simulate human motion. During Phase II-A, an existing cockpit design (A-7E) was partially evaluated by the CGECPS. The results were compared with human factors data and the CGE system correctly analyzed more than 80% of the tasks performed. The validation of the man-model joint movement parameters was also continued in Phase II-A by comparing them with human movement parameters. The comparison results indicated that the Phase II-A man-model developments which were primarily oriented towards improving the computer efficiency of the man-model have also improved the accuracy of the man-model. Author (GRA)

N72-25173* National Aeronautics and Space Administration.
 Goddard Space Flight Center, Greenbelt, Md.
LOCATION IDENTIFICATION SYSTEM Patent
 Robert L. Trent, inventor (to NASA) 23 May 1972 19 p Filed 13 Jul. 1970
 (NASA-Case-ERC-10324; US-Patent-3,665,313;
 US-Patent-Appl-SN-54270; US-Patent-Class-325-55;
 US-Patent-Class-325-38; US-Patent-Class-325-51;
 US-Patent-Class-325-58; US-Patent-Class-325-64;
 US-Patent-Class-325-141; US-Patent-Class-325-302;
 US-Patent-Class-325-325; US-Patent-Class-178-69.5;
 US-Patent-Class-340-167) Avail: US Patent Office CSCL 17B

A location identification system for identifying a particular ground location from among a plurality of ground locations is reported. Each ground location includes a transmitter that transmits a continuous tone signal when the transmitter is activated. Each transmitter also includes a binary encoder for encoding the continuous tone signal at spaced intervals. Each binary code uniquely identifies the particular transmitter with which it is associated. An aircraft flying above ground locations carries a receiver for receiving the continuous tone signal transmitted by an activated transmitter, and a decoder for decoding the binary encoded portion of the signal. A display device is provided for displaying the identity of the ground location determined as a result of decoding the encoded portion of the signal. Official Gazette of the U.S. Patent Office

N72-25273# Royal Aircraft Establishment, Farnborough (England).

OUTPUT FILTERS FOR AIRCRAFT TYPE CYCLOCONVERTORS

N. J. Carter Apr. 1971 44 p refs

(RAE-TR-71088; BR26007) Avail: NTIS HC \$4.25

The performance of low-pass filters, suitable for cycloconvertors which might be used for the prime electrical power supply in aircraft is analyzed and discussed. Three types of filter are considered, and a computer program is used to determine the response of the filters when loads of various power factors are applied. The analysis concludes that the L section filter represents the optimum arrangement for cycloconverter applications.

Author (ESRO)

N72-25296 California Inst. of Tech., Pasadena.

AN INVESTIGATION OF A TWO-DIMENSIONAL PROPULSIVE LIFTING SYSTEM Ph.D. Thesis

Carl Alvin Shollenberger 1971 121 p

Avail: Univ. Microfilms Order No. 71-27109

Several aspects of the nonhomogeneous flow associated with a system combining lifting and propulsive requirements of an aircraft are considered in detail by analytical and experimental methods. The principles governing flow with energy addition are examined. Basic equations and boundary conditions are developed for the complete inviscid and incompressible analysis for the two-dimensional case. The corresponding flow singularities are discussed and the integral equations which completely specify the system are derived. The two special cases of small and large energy addition are considered in detail including solutions. A numerical procedure is developed to solve the full problem including allowance for the wake deflection. Appropriate vorticity forms are used to represent the entire system. An iterative scheme is presented which rapidly converges to a solution for the magnitude and location of the system vorticity distributions. Forces and moments are evaluated on the propulsive lift system.

Dissert. Abstr.

N72-25313# Transportation Systems Center, Cambridge, Mass.

AIRCRAFT WAKE VORTEX SENSING SYSTEMS

D. Burnham, M. Gorstein, J. N. Hallock, R. Kodis, T. Sullivan, and I. G. McWilliams 30 Jun. 1971 65 p refs

(DOT/TSC Proj. R-2106; DOT-IA-FA-205)

(DOT-TSC-FAA-72-13) Avail: NTIS HC \$5.25

Active and passive techniques are analyzed that could be used to detect and measure air movements associated with wingtip vortex generation within an area or throughout a volume of terminal airspace. Usable techniques are indicated with an appraisal of expected performance and inherent limitations. Results of preliminary feasibility tests employing available technology are presented. The systems studies to be performed on the wake vortex sensing problem are discussed. The major effort is directed toward the location of wake vortex hazard, and the generation of monitoring requirements for safe operation in the airport terminal environment.

Author

N72-25320# Illinois Inst. of Tech., Chicago. Dept. of Mechanical and Aerospace Engineering.

VISUALIZATION OF UNSTEADY FLOW OVER OSCILLATING AIRFOILS

George H. Ruiter, Hassan M. Nagib, and Andrew A. Fejer Sep. 1971 39 p refs Presented at Symp. on Turbulence Measurements in Liquids, 2d, Rolla, Mo., 1971

(Contract F44620-69-C-0022; Grant NSF GK-17748; AF Proj. 9560)

(AD-738304; IIT-THEMIS-R71-6; AFOSR-72-0076TR) Avail: NTIS CSCL 20/4

The study is concerned primarily with the complex nature of leading edge flow separation occurring on airfoils oscillating in a uniform flow field at low Reynolds numbers. The flow field past an oscillating airfoil and a fixed airfoil with an oscillating flap were investigated using various visualization techniques in water. The role of mean flow velocity, instantaneous angle of attack, mean angle of attack and amplitude and frequency of oscillation as well as the location of the support point are examined. The

results which were obtained over a range of parameters substantially beyond previous studies include new information regarding the effect of these parameters on the nature and onset of separation.

GRA

N72-25420# Advisory Group for Aerospace Research and Development, Paris (France).

FLIGHT TEST INSTRUMENTATION SERIES. VOLUME 3: THE MEASUREMENT OF FUEL FLOW

J. T. France Mar. 1972 32 p refs

(AGARDograph-160-Vol-3; AGARD-AG-160-Vol-3) Avail: NTIS HC \$3.75

The main methods of fuel flow measurement are discussed and the prospective user is advised of the factors that should be considered in deciding which type of meter to use and what precautions to take in the installation. Details are given of the three main types of flowmeters in common use, namely: turbine, orifice and angular momentum true mass. The theory of operation of each type of flowmeter is given together with details of accuracy, pressure drop, susceptibility to inlet and outlet conditions, form of output, and other key parameters likely to influence the choice of type of meter to be used. A quick reference summary is provided for the comparison of the performance of the three types of meter and various methods of calibrating flowmeters are discussed. A separate section is devoted to specialist flowmeters which are not in general use, but may have an application in flight test work. Particular emphasis is placed on solid state flowmeters which, due to the need to obtain improved life and reliability, are the subject of much research work.

Author

N72-25426# National Aviation Facilities Experimental Center, Atlantic City, N.J.

A SUMMARY ON ALTITUDE DISPLAYS WITH AN ANNOTATED BIBLIOGRAPHY Final Report, Nov. 1971 - Feb. 1972

Jack J. Shrager May 1972 81 p refs

(FAA Proj. 076-311-01X)

(FAA-RD-72-46; FAA-NA-72-6) Avail: NTIS HC \$6.75

A review of all literature published since 1960 relating to aircraft height or altitude display was made. This review was supplemented by a series of conferences with experimentalists currently working in this field. The results of the literature review and series of conferences are evaluated and summarized, and this is further supplemented by an annotated bibliography of the documents included in the literature review.

Author

N72-25435# Joint Publications Research Service, Arlington, Va.

GEOGRAPHICAL LIMITATIONS OF AN APPROXIMATE COMPENSATION OF AIRPLANE MAGNETIC FIELDS

V. L. Kantorovich *In its Geophys. Equipment* 25 May 1972 p 30-34 refs

Avail: NTIS HC \$5.75

Problems involved in airborne magnetometry are discussed which result from the changing inductive field of the aircraft moving through the geomagnetic field with variable direction and

N72-25461 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).

ULTRASONIC INSPECTION OF VISCOUNT AIRCRAFTERS JOINTS AND LUGS

L. X. Nepomuceno 18 May 1971 8 p

(TR-7105.512) Avail: Issuing Activity

The results of a periodic ultrasonic inspection of the wing spar attachment joints on the Viscount Aircraft CX-AQO are reported. Cracked areas were reinspected and results compared to the results of the previous inspection. Photographs of the echograms are included.

F.O.S.

N72-25468*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

QUASI-ONE-DIMENSIONAL COMPRESSIBLE FLOW ACROSS FACE SEALS AND NARROW SLOTS. 1: ANALYSIS

John Zuk, Lawrence P. Ludwig, and Robert L. Johnson
Washington May 1972 39 p refs

(NASA-TN-D-6668; E-6819) Avail: NTIS HC \$3.00 CSCL 11A

An analysis is presented for compressible fluid flow across shaft face seals and narrow slots. The analysis includes fluid inertia, viscous friction, and entrance losses. Subsonic and choked flow conditions can be predicted and analyzed. The model is valid for both laminar and turbulent flows. Results agree with experiment and with solutions which are more limited in applicability. Results show that a parallel film can have a positive film stiffness under choked flow conditions. Author

N72-25479*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPARATUS FOR WELDING BLADES TO ROTORS Patent Application

Kenneth H. Holko and Thomas J. Moore, inventors (to NASA)
Filed 24 Apr. 1972 12 p

(NASA-Case-LEW-10533-2; US-Patent-Appl-SN-247055) Avail: NTIS HC \$3.00 CSCL 13H

The use of magnetic force upset welding to form T-joints between parts of dissimilar thicknesses is discussed. This type of resistance welding is used to join compressor and turbine parts, thereby reducing the weight and cost of a jet engine. NASA

N72-25493# Advisory Group for Aerospace Research and Development, Paris (France).

LASER TECHNOLOGY IN AERODYNAMIC MEASUREMENTS AGARD Lecture Series

R. C. Pankhurst, ed. Mar. 1972 249 p refs Presented at Rhode-Saint-Genese, Belgium, 14-18 Jun. 1971; sponsored by AGARD. Fluid Dyn. Panel and von Karman Inst. for Fluid Dyn. (AGARD-LS-49) Avail: NTIS HC \$14.50

The proceedings of a conference on the use of lasers for measuring aerodynamic applications are presented. The subjects discussed are: (1) principles of holography, (2) mathematical methods in coherent optical systems analysis, (3) laser beams for aerodynamic flow field analysis, (4) laser Doppler velocimeters for wind tunnel applications, (5) laser applications for high speed photography, and (6) laser metrology.

N72-25506# ARO, Inc., Arnold Air Force Station, Tenn. Experimental Research.

APPLICATION OF DUAL SCATTER LASER DOPPLER VELOCIMETERS FOR WIND TUNNEL MEASUREMENTS

A. E. Lennert, F. H. Smith, and R. L. Parker In AGARD Laser Technol. in Aerodyn. Meas. Mar. 1972 16 p refs

Avail: NTIS HC \$14.50

A dual scatter laser Doppler velocimeter (LDV), used in both forward and back scatter modes, and a direct data readout system are described. The characteristics of the dual scatter system are such that no seeding of flow is required to effect the measurements. With minor modifications and improvements, the dual scatter LVD system, both forward and back scatter, supplants conventional measuring devices. Descriptions of the application of the instrument to actual wind tunnel measurements including calibration of a one-foot transonic wind tunnel, flow field measurements of a simulated helicopter downwash, and flow field mapping across a high lift wing section are included. Author

N72-25542*# North American Rockwell Corp., Downey, Calif. Space Div.

THERMAL DESIGN OF COMPOSITE MATERIALS HIGH TEMPERATURE ATTACHMENTS Final Report

May 1972 135 p refs

(Contract NAS8-27041)

(SD-72-SH-0015; NASA-CR-123572) Avail: NTIS HC \$8.75 CSCL 11D

The thermal aspects of using filamentary composite materials as primary airframe structures on advanced atmospheric entry spacecraft such as the space shuttle vehicle were investigated to identify and evaluate potential design approaches for maintaining composite structures within allowable temperature limits at thermal protection system (TPS) attachments and/or penetrations. The investigation included: (1) definition of thermophysical data for composite material structures; (2) parametric characterization and identification of the influence of the aerodynamic heating and attachment design parameters on composite material temperatures; (3) conceptual design, evaluation, and detailed thermal analyses of temperature limiting design concepts; and (4) the development of experimental data for assessment of the thermal design methodologies and data used for evaluation of the temperature-limiting design concepts. Temperature suppression attachment concepts were examined for relative merit. The simple isolator was identified as the most weight-effective concept and was selected for detail design, thermal analysis, and testing. Tests were performed on TPS standoff attachments to boron/aluminum, boron/polyimide and graphite/epoxy composite structures. Author

N72-25584# Bureau of Mines, Bartlesville, Okla.

A FIELD SURVEY OF EMISSIONS FROM AIRCRAFT TURBINE ENGINES

F. W. Cox, F. W. Penn, and J. O. Chase 1972 32 p refs
(BM-RI-7634) Avail: NTIS HC \$3.75

Exhaust emissions were measured from 25 aircraft turbine engines using Jet A fuel. Analytical apparatus, procedures, and results are described. Carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, and aldehydes were measured at engine operating modes representing power levels used in airline operation. Carbon monoxide, hydrocarbon, and aldehyde emissions were highest at idle and lowest at takeoff; oxides of nitrogen were lowest at idle and highest at takeoff. Of the total oxides of nitrogen emitted, nitrogen dioxide constituted from 10 to 100 pct, depending on the exhaust gas temperature. Engines retrofitted with smoke reducing burner cans produced less carbon monoxide, hydrocarbon, and aldehyde emissions, and slightly more oxides of nitrogen than engines with standard burner cans. Author

N72-25589# Scott Research Labs., Inc., Plumsteadville, Pa.

A STUDY OF AIRCRAFT POWERPLANT EMISSIONS Final Report

Anthony F. Souza 3 Jan. 1971 260 p refs
(Contract EPA-68-04-0037)

(PB-207107; APTD-0916) Avail: NTIS CSCL 13B

Emissions from forty-two light aircraft piston engines and twenty-six military gas turbine engines were measured and documented. Piston engine aircraft were leased from local general aviation suppliers and the engine exhaust emissions tested using a ten mode test cycle during a ground run-up. In addition, crankcase ventilation emissions were measured on six engines and mass emission rates were calculated. Exhaust component concentrations and fuel consumption rates were measured at specified engine operating conditions. The exhaust analyzer readings were converted to pollutant concentrations and mass emission rates. The data were analyzed to determine engine-to-engine variations for each model engine, the effect of hot versus cold start, and the role of engine operating parameters. Author (GRA)

N72-25593# Pratt and Whitney Aircraft, East Hartford, Conn. **COLLECTION AND ASSESSMENT OF AIRCRAFT EMISSIONS BASELINE DATA, TURBINE ENGINES Final Report**

A. W. Nelson Feb. 1972 175 p ref
(Contract EPA-68-04-0027)

(PB-207321; PWA-4339) Avail: NTIS CSCL 13B

A report is presented of a study in which the design and fabrication of a multipoint sampling rake was completed. A

checkout test of the rake using a JT9D experimental engine indicated that the exhaust emission sample obtained from the rake was very close to the average of the samples obtained from the individual probes located adjacent to the 12 rake sampling points. This probe was then used to sample the exhaust emission from an experimental engine of each of the JT3D, JT8D, and JT9D engine models, plus production engines. All of the mass emission results obtained during the program were subjected to a statistical analysis. The results of this analysis were then used in a hypothetical aircraft operational cycle. Measurements of smoke, dry particulates, total particulates, aldehydes, and olefins were also recorded. Author (GRA)

N72-25595* Bell Aerosystems Co., Buffalo, N.Y.
FLIGHT CONTROL SYSTEM Patent
 William A. Collins, inventor (to NASA) Issued 16 May 1972
 10 p Filed 31 Jul. 1970

(NASA-Case-MSC-13397-1; US-Patent-3,662,973;
 US-Patent-Appl-SN-59966; US-Patent-Class-244-23A;
 US-Patent-Class-244-1SA) Avail: US Patent Office CSCL 17G
 A thrust control device which may be used with aircraft and spacecraft is described. The roll movements of the craft are controlled through differential throttling of the thrust engines. The pitch and yaw movements are controlled by pivotal movements of the thrust engines. The device has a trimming mechanism to respond to a variety of loading conditions without changing the position of the vehicle operator's controls. P.N.F.

N72-25601* National Aeronautics and Space Administration.
 Goddard Space Flight Center, Greenbelt, Md.
NASA BALLOON: AIRCRAFT RANGING, DATA AND VOICE EXPERIMENT
 Sheldon Wishna, C. Hamby, and D. Reed May 1972 69 p refs
 (NASA-TM-X-65906; X-752-72-136) Avail: NTIS HC \$5.50
 CSCL 17G

A series of tests to evaluate, at L-band, the ranging, voice, and data communications concepts proposed for the air traffic control experiment of the Applications Technology Satellite-F are described. The ground station facilities, balloon platforms and the aircraft were supplied by the European Space Research Organization. One ground simulation and two aircraft flights at low elevation angles were conducted. Even under high interference conditions good performance was obtained for both voice communications and side tone ranging. High bit errors occurred in the data channels resulting in false commands. As a result of the experience gained in operating the equipment in an aircraft environment several recommendations were made for improving the equipment performance. Author

N72-25602# Radio Technical Commission for Aeronautics, Washington, D.C.
PLANNED EXPANSION OF FAA TERMINAL NAVAID FACILITIES AND THE RESULTANT NEED FOR CHANNEL SPLITTING IN THE VOR/ILS/DME BANDS
 6 Jul. 1971 86 p
 (Paper-54-71/SC122-3) Avail: NTIS HC \$6.50

The planned expansion of terminal navigation aid facilities and the resultant requirement for channel splitting in the VOR/ILS/DME bands is discussed. Subjects involved in the discussion are: (1) requirements and programs for ILS and VOR, (2) principles of frequency management, (3) geographical separation criteria, (4) computer capability for frequency assignment, (5) present situation in VOR/ILS/DME bands, and (6) plan for phasing in split-channel assignments. Author

N72-25603# Radio Technical Commission for Aeronautics, Washington, D.C. Special Committee 116F.
MINIMUM OPERATIONAL CHARACTERISTICS FOR AIRBORNE VHF OMNIRANGE (VOR) SYSTEMS
 14 Jan. 1972 38 p refs
 (DO-149) Avail: NTIS HC \$4.00; RTCA Secretariat, Suite 655, 1717 H St., N. W., Washington, D. C. 20006: HC \$6.00

The requirements for establishing minimum operational characteristics of VHF omnirange navigation systems (VOR) are presented. Subjects discussed are: (1) equipment specifications and environmental standards, (2) international standards, (3) preparation of minimum operational characteristics for airborne VOR systems, and (4) demonstration of compliance and guidance material. P.N.F.

N72-25605# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF STOL MODULAR INSTRUMENT LANDING SYSTEM (MODILS) Final Report, May 1970 - Jul. 1971
 Glen D. Adams May 1972 53 p
 (FAA Proj. 320-114-02X)
 (FAA-NA-72-11; FAA-RD-72-4) Avail: NTIS HC \$4.75

The FAA procured two modular instrument landing system (MODILS) ground stations for short take-off and landing (STOL) operational evaluation. MODILS operated at 5.2 GHz (C-band solid-state transmitter), providing localizer and glide slope signals, from a common site, for approach guidance to aircraft equipped with a MODILS receiver. Proportional guidance is provided from 3 to 12 deg elevation and about +30 deg in azimuth. The pilot may select his glide slope angle in increments of 0.1 deg and one of three localizer courses: parallel to runway centerline, 2 deg skew one side and 6 deg skew the other side. The pilot may also select his indicator sensitivities. An integral distance measuring equipment (DME) is included which provides readouts to 0.01 nmi. The system provides good quality guidance signals to adequately support Category I type (200-foot decision height) operations. The consistent DME operating range is about 5 nmi. The monitors are not of commissionable quality due to reliability and stability problems. Author

N72-25606# Royal Aircraft Establishment, Farnborough (England).

A REVIEW OF APPROACH AND LANDING GUIDANCE IN RELATION TO CIVIL AND MILITARY OPERATIONAL REQUIREMENTS

J. Benjamin Sep. 1971 112 p refs
 (RAE-TR-71186; BR27181) Avail: NTIS HC \$7.75

Trends and developments in aircraft guidance and the likely long term effect on aircraft instrumentation and operations are reviewed. Several organizations are engaged in the formulation of operational requirements suited to the foreseeable needs of civil and military aviation, and effort was devoted to the development of a variety of techniques applied to guidance using microwaves. These requirements, and the solutions that were conceived, constitute a complex technical, commercial, and political pattern. Author (ESRO)

N72-25607# Royal Aircraft Establishment, Farnborough (England).

AN ILS APPROACH PROGRAMME UNIT FOR THE RADIO ENVIRONMENT MONITOR

T. R. G. Lampard Jul. 1971 66 p ref
 (RAE-TR-71145; BR27441) Avail: NTIS HC \$5.50

A program unit is described which is capable of providing appropriate voltage levels into a signal simulator which in turn supplies the necessary RF signal input to the radio environment monitor in such a way as to simulate an ILS approach by an aircraft. The approach can be simulated with or without the various forms of interference which the monitor is capable of detecting. Author (ESRO)

N72-25632# Pratt and Whitney Aircraft, East Hartford, Conn.
APPLICATION OF THEORETICAL ACOUSTIC TO JET ENGINE NOISE REDUCTION

J. D. Kester and G. F. Pickett [1971] 20 p refs Presented at Conf. on Reduction of Aircraft Noise, Bristol, Engl., 13-14 Jan. 1971 Sponsored in Part by FAA
 Avail: NTIS HC \$3.00

A now classical example of the application of theory to rotor-stator interaction noise is discussed to illustrate how noise

generation, propagation, and reduction data can be obtained from a simple theoretical model. Some of the problems arising from predicting noise levels of interaction tone noise are considered. Some of the more recent work associated with the study of combination tone or multiple pure tone noise is described. This noise is produced in the inlets of turbofan engines whenever the fan blades have supersonic relative tip speeds. Results of large scale fan tests are used to illustrate the physical characteristics of this noise. A mathematical model is introduced that determines the importance of blade shock wave spacing in the noise generation process. Finally, a method of estimating the standard deviation of shock wave spacing is presented and compared with full scale data. Author

N72-25636# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

GENERAL METHOD FOR COMPUTATION OF THE ACOUSTIC FIELD GENERATED BY AIRCRAFT JETS

Michel Kobrynski 1971 31 p refs In FRENCH: ENGLISH summary (ONERA-NT-187) Avail: NTIS HC \$3.75

A method was developed for computing the noise generated by standing and flying aircraft from known mathematical expressions of the sound pressure in the far acoustic field of a circular, stationary, subsonic jet. An expression representing the local sound pressure generated by stationary or mobile jets and its acoustic spectrum are determined and solved by computer. Computation was carried out for various types of aircraft and for several cases for which the mean discrepancy appeared to be of the same order within angles from - 20 deg to + 100 deg relative to the maximum emission direction. In obtuse angles relative to the jet axis there appears in flight, for fast jet, a systematic increase of the observed global noise levels, as compared to the computed ones, this discrepancy increasing with the flight Mach number. Several assumptions are proposed concerning the interaction phenomena indicated by this method. Author (ESRO)

N72-25711*# AiResearch Mfg. Co., Los Angeles, Calif. **HYPERSONIC RESEARCH ENGINE PROJECT. PHASE 2: STRUCTURES AND COOLING DEVELOPMENT** Interim Technical Report, 3 May - 2 Aug. 1970

L. F. Jilly 1, Sep. 1970 98 p refs (Contract NAS1-6666) (NASA-CR-112055; AP-70-6640; ITR-14) Avail: NTIS HC \$7.00 CSCL 21E

The flightweight components were adapted to form the basic engine assembly. The water cooled test adapters for use in wind tunnel tests were fabricated. Commercially available valves were selected for the coolant control system. The simplification of the temperature control concept and of the absence of weight and volume constraints made it possible to use these valves. Various calibration tests are also discussed. J.A.M.

N72-25712*# AiResearch Mfg. Co., Los Angeles, Calif. **HYPERSONIC RESEARCH ENGINE PROJECT. PHASE 2: STRUCTURES AND COOLING DEVELOPMENT** Interim Technical Data Report, 3 Aug. - 2 Nov. 1970

L. F. Jilly, ed. 24 Nov. 1970 33 p (Contract NAS1-6666) (NASA-CR-112056; AP-70-6939; ITDR-15) Avail: NTIS HC \$3.75 CSCL 21E

The structures assembly model (SAM) was installed, and wind tunnel systems were checked out. The first run, with hydrogen cooling and SAM inserted in the wind tunnel stream ($M = 7.7$, P sub TOTAL = 900 psia, T sub TOTAL = 2500 deg R), was accomplished. The condition of the SAM after the run was satisfactory, with no visible signs or data indications of overheating or overloading. Author

N72-25713*# AiResearch Mfg. Co., Los Angeles, Calif. **HYPERSONIC RESEARCH ENGINE PROJECT. PHASE 2: AEROTHERMODYNAMIC INTEGRATION MODEL DEVELOPMENT** Interim Technical Data Report, 10 Jun. - 9 Sep.

1970

L. F. Jilly, ed. 15 Oct. 1970 100 p refs (Contract NAS1-6666) (NASA-CR-112058; AP-70-6800; ITDR-10) Avail: NTIS HC \$7.00 CSCL 21E

The analytical effort was directed towards (1) completing the design of the combustor exit instrumentation assembly, (2) analyzing the coolant flow distribution of the cowl leading edge tip section, (3) determining effects of purge gas pressure on AIM performance analysis, and (4) analyzing heat transfer and associated stress problems related to the cowl leading edge tip section and the nozzle shroud assembly for test conditions. Author

N72-25714*# AiResearch Mfg. Co., Los Angeles, Calif. **HYPERSONIC RESEARCH ENGINE PROJECT. PHASE 2: AEROTHERMODYNAMIC INTEGRATION MODEL DEVELOPMENT** Interim Technical Data Report, 10 Sep. - 9 Dec. 1970

L. F. Jilly, ed. 6 Jan. 1971 74 p (Contract NAS1-6666) (NASA-CR-112059; AP-70-7035; ITDR-11) Avail: NTIS HC \$5.75 CSCL 21E

The analytical effort was directed toward (1) analyzing the latest inputs of possible test conditions and their impact on hardware; (2) review structural capabilities of the AIM unit; (3) analyzing coolant flow paths, heat transfer, and associated problems relative to the cowl leading edge tip section; and (4) redefining requirements of flow-calibrating the air-metering duct. Author

N72-25715*# AiResearch Mfg. Co., Los Angeles, Calif. **HYPERSONIC RESEARCH ENGINE PROJECT. PHASE 2: AEROTHERMODYNAMIC INTEGRATION MODEL DEVELOPMENT** Interim Technical Data Report, 10 Dec. 1970 - 9 Mar. 1971

L. F. Jilly, ed. 30 Mar. 1971 31 p refs (Contract NAS1-6666) (NASA-CR-112060; AP-71-7279; ITDR-12) Avail: NTIS HC \$3.75 CSCL 21E

The fabrication of the various components of the HRE AIM was completed. The purge system necessary for the cavity bounded by the outer shell assembly and the outer cowl body was studied. Preparations were begun for establishing a format for test data acquisition and reduction. Author

N72-25783*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN ADAPTIVE NARROW BAND FREQUENCY MODULATION VOICE COMMUNICATION SYSTEM

Sheldon Wishna In its Significant Accomplishments in Technol., GSFC, 1970 1972 p 119-121 Avail: NTIS HC \$3.00 CSCL 17B

A narrow band frequency modulation communication system is described which provides for the reception of good quality voice at low carrier-to-noise ratios. The high level of performance is obtained by designing a limiter and phase lock loop combination as a demodulator, so that the bandwidth of the phase lock loop decreases as the carrier level decreases. The system was built for the position location and aircraft communication equipment experiment of the ATS 6 program. Author

N72-25898# Technological Lab., RVO-TNO, Rijswijk (Netherlands).

PRELIMINARY INVESTIGATION OF THE VIBRATION OF THE WALLS OF THE TEST CELL FOR J-79-11A TURBOJET ENGINE TYPES [VOORONDERZOEK VAN DE TRILLINGEN VAN DE MUREN VAN DE TESTCEL VOOR STRAALMOTOREN VAN HET TYPE J-79-11A BIJ GSMW OP DE VLEGBASIS WOENSRECHT]

6 Aug. 1971 8 p In DUTCH (TL-1971-11; TDCK-58326) Avail: NTIS HC \$3.00

Measurements of vibration velocities, accelerations, and frequencies on inside and outside walls of a three dimensional place are reported. Results show that the possibility of crack formation exists and should be further explored. Transl. by G.G.

N72-25899# Aeronautical Research Labs., Melbourne (Australia). **THE FATIGUE LIFE OF SAFE LIFE AND FAIL-SAFE STRUCTURES: A STATE-OF-THE-ART REVIEW**
F. H. Hooke Jun. 1971 62 p refs
(ARL/SM-Rept-334) Avail: NTIS HC \$5.25

A review is made of the theory and practice for assessment of safe life and fail-safe structures, and of determinations of safe inspection intervals for fail-safe structures. The problem is one involving statistical variability and estimates are made of the intrinsic uncertainty in defining, for example, scatter factors, safe lives, or probabilities of failure. The greatest uncertainties arise from the inference of population mean, variance and distribution shape parameters from tests on small samples or samples not properly representative of the geometry or the actual service load history. Consideration is given to defining the optimum test load history to represent service conditions. Author

N72-25918# Rome Univ. (Italy). **AN EXPERIMENTAL METHOD FOR MEASURING HEAT TRANSFER IN HYPERSONIC AERODYNAMIC MODELS [UN METODO SPERIMENTALE PER LA MISURA DEI FLUSSI DI CALORE NEGLI IMPIANTI AERODINAMICI IPERSONICI]**
Ugo Ponzi Nov. 1970 15 p refs In ITALIAN; ENGLISH summary
(Rept-32) Avail: NTIS HC \$3.00

Starting with the conductive heat transfer theory according to Broglie's formula, an experimental method is obtained for measuring the heat transfer rate on a hypersonic model. With this method, knowing the $N(2)$ influence coefficients, and the time functions, which can be determined by applying the known heat rate to the model, the heat rates are determined by measuring the temperatures in N points of the model. The method yields the heat transfer rates directly from the temperature measurement. Author

N72-25945# Committee on Science and Astronautics (U. S. House). **AERONAUTICAL RESEARCH AND DEVELOPMENT**
Washington GPO 1972 947 p refs Hearings before Comm. on Sci. and Astronaut., 92d Congr., 2d Sess., No. 17, 18-20 Jan. 1972
Avail: Subcomm. on Aeron. and Space Technol.

The hearings concerning aeronautical research are reported. Topics discussed include: civil aviation R and D (CARD), national transportation policy, industry response to CARD study, aircraft noise abatement, aircraft safety, and short haul aircraft programs. The Airport Operators Council International Policy Handbook is included. F.O.S.

N72-25948# Committee on Commerce (U. S. Senate). **TRANSPORTATION OF GOVERNMENT TRAFFIC BY CIVIL AIR CARRIERS Report to accompany S. 1821**
Cannon Washington GPO 19 Nov. 1971 43 p refs
Presented by Comm. on Com. to 92d Congr., 1st Sess., 19 Nov. 1971
(S-Rept-92-503) Avail: US Capitol, Senate Document Room

A report is presented on the bill to amend the Federal Aviation Act with respect to the transportation of Government passengers and cargo, both military and civilian, by U.S. civil air carriers. The provisions and background of the bill are outlined, and the current and anticipated military and civilian needs are discussed. It is concluded that the Military Airlift Command (MAC) aircraft are in excess of those needed for training and readiness maintenance. The net current costs to the Government would be reduced by using civil carriers for cargo transportation instead of MAC carriers. The strategic airlift capability of the Civil Reserve Air Fleet is essential and must be maintained, and the cost of maintaining it by assuring business to the civil carriers is

far less than the cost of providing and maintaining equivalent capability in MAC. N.E.N.

N72-25949# Federal Aviation Administration, Washington, D.C. **THE NATIONAL AVIATION SYSTEM POLICY SUMMARY**
1972 295 p refs
(Rept-1000.27-App-1) Avail: SOD \$2.25

The FAA's national policies are examined, including the broad policies, such as overall mission and objectives, and more specific policies that state the goals, requirements, and criteria for major subsystems. Route control and services, terminal area control and services, flight services, airspace allocation and rules, en route navigation aids, landing aids, system support, airports, manpower and training, and regulatory functions and aviation safety are discussed. Some engineering, development, and investment policies are also considered. J.A.M.

N72-25950# Federal Aviation Administration, Washington, D.C. **THE NATIONAL AVIATION SYSTEM PLAN 1973-1982**
1972 245 p refs
(Rept-1000.27-App-2) Avail: SOD \$2.00

The national aviation system plan for 1973 through 1982 is part of a creative joint industry-government program. The objectives and planning baselines for this program are discussed, along with cost estimates and plan funding. Various services are also considered, including en route control, terminal area control, and in-flight services. J.A.M.

N72-25952# Smithsonian Institution, Washington, D.C. **WILEY POST, HIS WINNIE MAE, AND THE WORLD'S FIRST PRESSURE SUIT, NUMBER 8**
Stanley R. Mohler and Bobby H. Johnson 1971 134 p refs
Avail: NTIS HC \$8.75

A biography of Wiley Post covering his entire lifetime and accomplishments in the field of aviation is presented. The significant events of his life which are reported are as follows: (1) globe circling flight with Gatty in 1931, (2) solo flight around the world in 1933, (3) development and test of pressure suit for altitude flight, (4) stratosphere flights during 1934 to 1935 time period, and (5) flight to Point Barrow, Alaska with Will Rogers which ended in fatal accident to both men. A large number of photographs are included to supplement the written reports. P.N.F.

N72-25960# Committee on Commerce (U. S. Senate). **TRANSPORTATION OF GOVERNMENT TRAFFIC BY CIVIL AIR CARRIERS**
Washington GPO 1972 157 p refs Hearing on S. 182 before Comm. on Com., 92d Congr., 1st Sess. 24 Jun. and 30 Sep. 1971
Avail: Subcomm. on Aviation

Hearings by the aviation subcommittee on DOD use of civil aircraft are reported. Civil airlines, holding options on air cargo by the military, want an amendment requiring DOD to transport at least 50% of its air cargo with them. Such an amendment is needed, it was argued, because almost all air cargo is presently being shipped by military means; yet these companies were sold rights to the transportation and are losing money. E.H.W.

N72-25961*# National Aeronautics and Space Administration, Washington, D.C. **GOVERNMENT-INDUSTRY SYSTEM SAFETY CONFERENCE**
28 May 1971 283 p refs Conf. held at Greenbelt, Md., 26-28 May 1971
(NASA-TM-X-68369) Avail: NTIS HC \$16.25 CSCL 13L

Conference papers are presented relating to all aspects of the systems approach to safety and its application in governmental and industrial projects.

N72-25967*# Army Board for Aviation Accident Research, Fort Rucker, Ala.

THE PRACTICAL APPLICATION OF MISHAP DATA IN ARMY AIRCRAFT SYSTEM SAFETY PROGRAMS

James T. Darrah, Jr. /n NASA, Washington Govt.-Ind. System Safety Conf. 28 May 1971 p 65-73 ref

Avail: NTIS HC \$16.25 CSCL 13L

The means are discussed by which the the United States Army Board for Aviation Accident Research (USABAAR) now utilizes the vast store of historical accident data in the application of the system safety concept for developmental aircraft USABAAR serves as the central agency for the Army Accident Prevention Program which includes the receipt, processing, and analysis of all data and information related to Army aircraft accident experience. It is pointed out that methods which served the cause of accident prevention so well in the past are no longer adequate and that traditional parameters used to measure mishap experience have become obsolete. USABAAR has developed, and recently put into use, completely revised accident reporting forms which greatly expand the scope and detail of information provided as a result of investigation. This and other factors which have resulted in an improved data system are discussed in detail. D.L.G.

N72-25969*# Martin Marietta Corp., Baltimore, Md.
PILOT SAFETY FOR THE X-24A LIFTING BODY VEHICLE

John Cochrane and Kenneth Graham /n NASA, Washington Govt.-Ind. System Safety Conf. 28 May 1971 p 87-95

Avail: NTIS HC \$16.25 CSCL 13L

The design and operational characteristics of the X-24A are described in detail. Primary emphasis is placed on the safety considerations incorporated in the design and flight test stages. It is pointed out that the inherently high drag of the lifting body configuration together with its relatively low lift/drag ratio, generated considerable concern with respect to the pilot's ability to perform safe landings from gliding flight. The resulting safety procedures taken at each stage of development are discussed. D.L.G.

N72-25974*# National Transportation Safety Board, Washington, D.C.

REQUIREMENTS FOR SYSTEMS SAFETY PROGRAMS AS DELINEATED BY MIL-STD-882

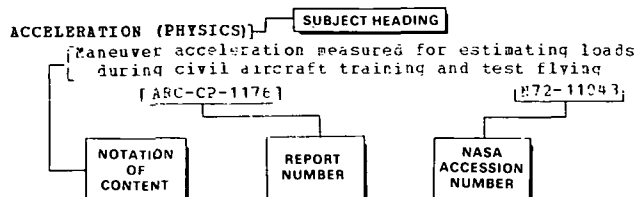
C. O. Miller /n NASA, Washington Govt.-Ind. System Safety Conf. 28 May 1971 p 137-146 refs

Avail: NTIS HC \$16.25 CSCL 13L

A specialized approach, based on MIL-STD-882, to recommended safety features of an air safety program for aircraft manufacturers, is summarized. E.H.W.

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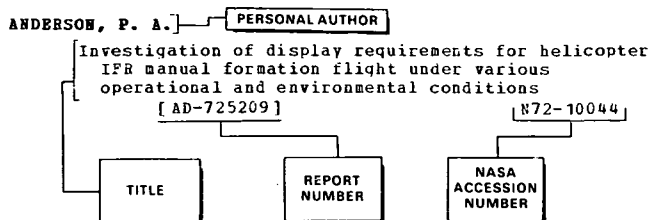
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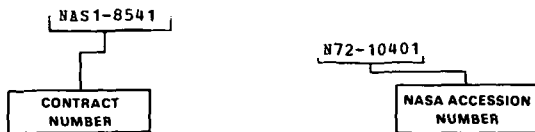
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